Clear the air:
A single step solution to meet all emissions requirements
The new era of filtration

FLSmidth Airtech’s catalytic filtration solutions offer the clear advantage of removing gaseous pollutants and dust in a single, compact installation.

Key benefits

- Single-step solution
- Tailor-made concept
- Low OPEX and CAPEX
- Easy integration
- Superior plant availability
- Better contact Reagent / Catalyst
Beat your toughest emissions challenges – and reduce costs
Dealing with emissions responsibly and efficiently is a fact of life for today’s production facilities. Authorities are ever-more demanding, enforcing tighter limits on specific substances and their allowable limits.

Most industries face the need to remove a growing list of gaseous pollutants from their emissions, including NO\textsubscript{x}, NH\textsubscript{3}, volatile organic compounds (VOCs), dioxins and furans, and particulate matter — all of which are a serious health hazard to the general public.

Compliance with environmental requirements is however demanding and potentially expensive. Choosing the right process solution is crucial. A wrong decision can lead to massive investments due to lack of compliance and process inefficiencies.

Today, filtration technologies play a key role in not only minimising environmental impact, but also reducing operating costs. An all-in-one catalytic technology solution is a cost-effective means of meeting the demands while helping maintain plant productivity.

Two ways to clearer air
FLSmidth Airtech provides two catalytic filtration solutions that effectively meet cement producers’ toughest demands for air pollution control. Both combine FLSmidth’s extensive process know-how and the newest ground-breaking technologies.

- The CataFlex™ catalytic filter bag applies unique, specially developed catalytic technologies to woven-glass bags.
- The CataMax™ catalytic solution is based on ceramic filtration technology.

Effective all-in-one gaseous pollutants and dust removal solution
Catalytic filtration solutions from FLSmidth Airtech have overcome a long-standing challenge in dealing with emissions: how to remove gaseous pollutants and dust in a single step.

The solutions are built to handle a high dust load. In other solutions, excessive dust can compromise catalyst performance due to clogging and catalyst poisoning. FLSmidth Airtech’s solutions, however, prevent clogging while providing the highest degree of protection for the catalyst, thanks to separation of dust and other harmful particles from the catalyst.

Design innovation
With these solutions, FLSmidth Airtech has cracked the code of reliability and high availability. Extensive thought has gone into simplifying implementation and maintenance during the design of the solutions to minimise CAPEX and OPEX requirements. The compact all-in-one equipment can be easily integrated into the plant. And as they are simple to use and have few controls, staff can be rapidly trained in how to operate the equipment. When up and running, maintenance procedures can be carried out on-line — a vital ingredient of maximising plant productivity.
**Efficient removal of hazardous pollutants**

**Optimal catalyst performance**
The catalytic filtration solutions offer a range of other important advantages that improve their effectiveness. This includes optimised conditions for chemical reaction, thanks to a design enabling cross-flow instead of by-flow. This allows the contaminated air – after dust has been removed – to be forced into deep contact with the catalyst reagents.

FLSmidth Airtech’s catalytic filtration solutions turn yesterday’s ordinary bag filters into a powerful dust filtration plus gaseous emissions control system.

The highly effective filters remove all harmful pollutants, in accordance with the demands of local authorities around the world.

**Dust** – The filtration process starts with the removal of dust. Not only does it comply with the highest emission standards, but it also protects the catalyst from dust, just as in a low-dust catalytic environment.

**NO\textsubscript{x}** – Selective catalytic reduction (SCR) makes use of ammonia to remove NO\textsubscript{x} from the off-gas, converting it into harmless nitrogen and water.

**NH\textsubscript{3}** – At the same time, NH\textsubscript{3} emission levels are minimised using highly effective ammonia slip control technology.

**Hazardous air pollutants** – The catalyst technology oxidizes a wide range of organic compounds into carbon dioxide and water. This includes all seven species defined by the US National Emissions Standards for Hazardous Air Pollutants (NESHAP), such as cyclic, aliphatic and aromatic hydrocarbons.

**Dioxins and furans** – These harmful substances are easily removed and transformed into harmless compounds.

**CO** – For some applications, CO can also be removed in the same temperature range as the other catalytic reactions with some integrations.

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![Diagram showing the flow of gases through the catalytic filtration system](image-url)
"The CataFlex catalytic filter bag technology enables a single bag to remove multiple gaseous compounds and dust in a single-step process".
Control gaseous emissions and dust in a single-step solution

CataFlex is a patent-pending filter bag built with embedded catalyst, especially designed to treat off-gasses in high-dust environments.

Highly effective and customisable for demanding industrial operations, CataFlex solutions are based on a universal design with a unique catalytic formula. They make use of selective catalytic reduction (SCR) technology to remove NOx, NH3, dioxins and a wide range of organic compounds – to the most stringent standards. The ePTFE membrane removes dust prior to the catalytic reaction at the highest achievable rates.

CataFlex catalytic filter bags provide exceptional resistance to catalyst poisoning thanks to no contact between the catalyst and potentially harmful particles.

Built to requirements

A CataFlex bag consists of up to three layers of woven fiberglass.

Each layer can feature its own unique catalytic formula, enabling the bag to remove multiple gaseous compounds and dust in a one-step process – eliminating the need for costly, space demanding tail-end gas removal equipment and ensuring future compliance.

Cost-reducing technology

Highly effective in a high temperature range, CataFlex provides the most durable solution in an integrated and cost-effective process.

It offers significantly lower CAPEX and OPEX compared with other technologies, while still meeting the strictest regulations.
CataFlex:
Simple, cost effective integration

In-house expertise
CataFlex is the result of a collaborative partnership between FLSmidth Airtech and Haldor Topsøe – a world leader in catalysis and surface science. FLSmidth has not only succeeded in merging two advanced technologies into one, but also gained the know-how to ensure complete control through all stages of development.

Since the bags are manufactured by our sister company FLSmidth AFT, and the catalyst is produced in a partnership, quality control and continuous technology improvement is carried out fully in-house.

FLSmidth has always invested considerably in developing and implementing new, innovative technology to improve productivity and reduce environmental impact. At the cement industry’s largest research centre, FLSmidth R&D Centre Dania, located in Denmark, new technology is constantly developed and refined through computational fluid dynamics (CFD) and validated through field research and R&D pilot-scale modelling.

It’s just what you can expect from an industry leader in catalytic filtration solutions.
What’s your solution?

The CataFlex solution you choose depends on the unique emission challenge you face.

**Ammonia slip killer** The CataFlex NH$_3$ slip killer helps you to comply with NO$_x$ and NH$_3$ emission levels when your facility emits excessive ammonia associated with selective non-catalytic reduction (SNCR). If the ammonia removal performance required is low, it might be possible a partial conversion.

**Bypass system** If your facility is close to meeting NO$_x$ or NH$_3$ limits with an SNCR system, it may not be necessary to make major modifications to the main kiln line. Instead, integrating a CataFlex bypass system is a cost-effective solution – especially as the kiln bypass system is responsible for more than 10 percent of total emissions.

**A complete SCR solution** When you need full deNO$_x$ capabilities, CataFlex can be implemented as a full SCR solution in your baghouse, where the thermal balance is adjusted to the optimal level.
As the only catalytic filter bag of its kind, CataFlex delivers entirely unique cost-saving benefits for both CAPEX and OPEX compared with using separately thermal oxidizers, SCR and filtration technologies.

**Upgrade? An affordable solution for every situation**
A CataFlex catalytic filter bag can be integrated rapidly into existing operations, typically in one of three ways:

**New installation**
Giving you access to FLSmidth Airtech’s extensive catalytic solution know-how as well as cost-reducing features and proven technology.

**Conversion from ESP**
Using the same, proven principles as converting from standard fabric filter, which minimises downtime to approximately four weeks in typical cases.

**Upgrading existing fabric filters**
The CataFlex design is similar to conventional filter bags and can easily be installed in an existing filter. The pressure drop across a CataFlex bag is comparable to that of a conventional filter bag. This means you do not need to invest in new or upgraded ID fans, compressors or other auxiliaries when upgrading your existing fabric filter to a catalytic fabric filter.
CataMax™
Catalytic solution

Air pollution control using the best of ceramic cleaning technology
The CataMax catalytic solution from FLSmidth Airtech is constructed similarly to a traditional bag filter, but using porous ceramic elements. It removes both dust and organic hazardous air pollutants (OHAPs) from the flue gas in a single step.

Simple operations and maintenance
Gas distribution in the filter is optimised to reduce the velocity profiles near the ceramic elements. This extends the elements’ lifetime and allows a more compact design and trouble-free operation.

Furthermore, the filter can be maintained while online and features the SmartPulse Controller®, a proven, new-generation controller using microprocessor technology to optimise the control of bag filters.

Dust from the gas stream is captured on the surface of the ceramic elements by pulsed, pressurised air. Inside, the harmful gases are trapped and removed in the matrix of the ceramics via a specially designed catalyst that converts and removes volatile organic compounds (VOCs) and NOx emissions. The initial removal of dust prevents it from deactivating the embedded catalyst.

FLSmidth CataMax helps the industry to achieve compliance with the latest regulations, including the US NESHAP regulations, in which restricting o-HAPS (organic hazardous air pollutants) is vital.

Ceramic elements installed in a CataMax catalytic filter.
CataMax or CataFlex
Choose the right solution for your needs

Removal efficiencies
The filter's catalytic ceramic elements achieve over 90 percent removal efficiency of many VOCs and NO\textsubscript{x}, keeping NH\textsubscript{3} slip levels extremely low. This high HAP removal efficiency allows cement plants to easily achieve the NESHAP HAP emission limit of 9 ppmdv at 7% O\textsubscript{2}.

The filtering element cake enhances deSO\textsubscript{x} dry sorbent injection techniques and the dust emission rates are at the highest standard of barrier air filtration – making CataMax the smartest choice as all-in-one multi-pollution control equipment.

Ceramic filtration
It can be applied in situations where the hot gas process does not have a catalyst, such as in a clinker cooler. It allows easy integration of a waste heat recovery system and does not need a heat exchanger.

Hot gas ceramic filtration
It can be applied in situations where the hot gas process does not require a catalyst, such as in a cement clinker cooler. It allows easy integration of a waste heat recovery system and does not need a heat exchanger. The use of ceramic candles without a catalyst makes this solution even more cost effective.

CataMax or CataFlex?
CataFlex is an excellent choice for facilities already using a filter bag solution. CataMax is the ideal solution for high-temperature filtration.

Regardless of the solution you choose, both remove dust and gaseous pollutants in a single step.

About FLSmidth Airtech
FLSmidth Airtech is a world leading supplier of sustainable equipment and services to the global minerals and cement industries. The company’s air pollution control technologies include a wide range of solutions for reducing particulate matter and gaseous emissions.

More than 8,000 FLSmidth air pollution control systems, including electrostatic precipitators and gas suspension absorbers, are installed world-wide.

<table>
<thead>
<tr>
<th>CataFlex\textsuperscript{®} catalytic filter bags</th>
<th>CataMax\textsuperscript{™} catalytic solution</th>
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<tbody>
<tr>
<td>Woven glass bags (1, 2 or 3 layers)</td>
<td>Rigid ceramic element</td>
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<tr>
<td>1 - 3 mm thickness, medium to high catalyst load</td>
<td>2 cm thickness, high catalyst load</td>
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<tr>
<td>(\Delta P) as standard fabric filters</td>
<td>(\Delta P) higher than standard fabric filters</td>
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<tr>
<td>200-260°C temperature window</td>
<td>200-400°C temperature window</td>
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<tr>
<td>Possible sensitivity to high SO\textsubscript{2} concentration within the operational temperature range</td>
<td>Low or no sensitivity to SO\textsubscript{2} in the higher temperatures range</td>
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