



viledon[®]

MAXIMIZING THE EFFICIENCY OF GAS TURBINES AND COMPRESSORS

**POWERFUL AND ECONOMIC SPECIALIST
AIR FILTRATION SOLUTIONS**

FREUDENBERG
FILTRATION TECHNOLOGIES

 **FREUDENBERG**
INNOVATING TOGETHER



COMPLETE AIR FILTRATION SOLUTIONS FROM A SINGLE SUPPLIER

HIGH-PERFORMANCE INDUSTRIAL AIR FILTRATION FOR DEMANDING APPLICATIONS

Freudenberg Filtration Technologies has been at the forefront of industrial air filtration for over 60 years, with particular expertise in the field of gas turbines and compressors. Our solutions reliably remove particles from the intake air of turbomachines, prevent fouling and maximize both their performance and overall cost efficiency. By preventing corrosion of turbine blades and the build-up of dust deposits on compressor blades, they also improve reliability, eliminate unplanned downtime and reduce maintenance costs. In addition, our solutions are always optimized to meet specific local conditions, such as high humidity, abnormal air pollution, extreme dust concentrations or saltwater spray.

Freudenberg Filtration Technologies offers you

- a complete design, development and installation program for modifying or building air filtration systems and housings for industrial gas turbines and compressors.
- a comprehensive air filter range for static and cleanable systems covering filters of ISO 16890 group classification ePM₁, ePM_{2.5} and ePM₁₀ (corresponds to filter classes G4 to F9 to EN 779) respectively EPA filter class level E10–E12 to EN 1822. This meets the highest demands of efficiency and operational reliability.

Integrated air filtration solutions, from A–Z

We provide complete filtration solutions, from design and build to a full range of filter consumables. Our experts will work with you from the earliest stages of your filtration project, right through to construction and commissioning. As well as new builds, we also undertake the retrofitting and modification of existing installations.

A dependable long-term partner

Freudenberg Filtration Technologies is part of the Freudenberg Group, a family-owned company that employs around 48,000 people in over 60 countries across the globe. Founded in 1849, Freudenberg has built its worldwide reputation on innovation strength, creativity, reliability, corporate responsibility and long-term business partnerships. This backing enables us to manage and deliver turnkey solutions of all sizes, from one-off projects to major service contracts.

AIR INTAKE SYSTEMS FOR OPTIMUM TURBINE PERFORMANCE

MAXIMIZING OPERATIONAL EFFICIENCY AND PROFITABILITY

Particulates in the intake air significantly affect the operational efficiency of gas turbines and turbocompressors. Our customized air filtration solutions prevent blade damage caused by fouling or corrosion, all of which adversely affect power output and profitability.

We tailor our solutions to take account of local climatic conditions, individual machine specifications or available space. For applications where filters are regularly exposed to water spray or fog, we offer a special coalescing and prefiltration concept with a “front of filter” drainage function. Our multi-stage concept uses a tailored combination of filter classes up to EPA filtration, where required. This allows turbines and compressors to be operated for longer periods with virtually no fouling, resulting in improved working life and increased economic viability.



+

Your benefits when using Viledon® filter systems

- Highest filter efficiency up to EPA purity level
- Optimized filters' longtime behavior with low pressure drops and high mechanical stability
- Maximized system protection (turbine + compressor blades)
- High system availability with predictable filter operation from planned downtime to downtime
- Verifiable cost savings for the operator
- High operational reliability in all environmental conditions

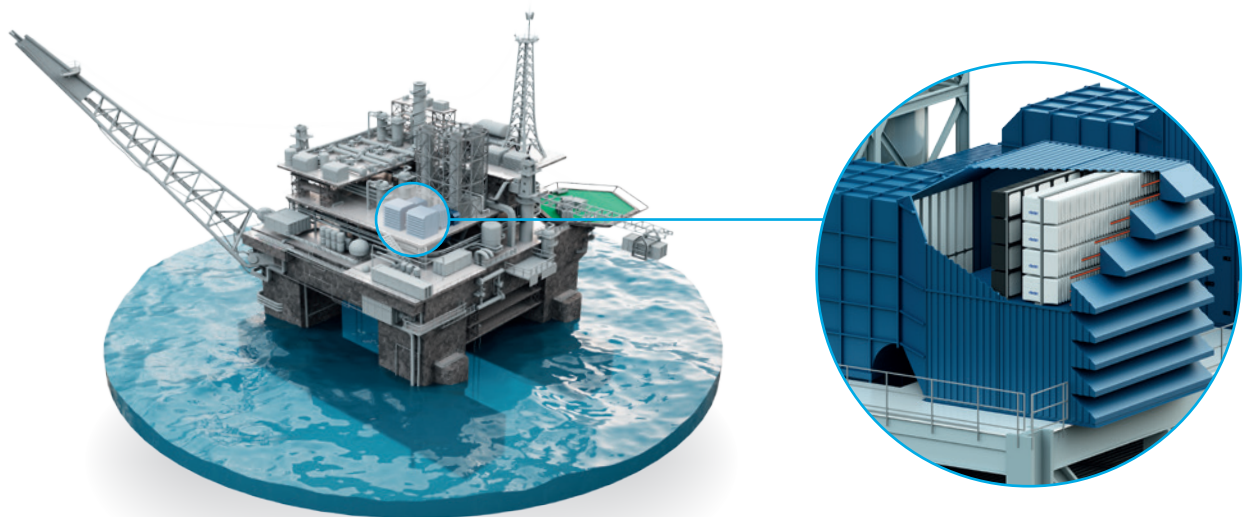
+

SECTOR-SPECIFIC EXPERTISE

INDIVIDUALLY DESIGNED SOLUTIONS TO MEET DEFINED CHALLENGES

Freudenberg has extensive experience in a wide spectrum of specialist sectors. No matter what the local conditions may be, including limited space or extreme contaminant levels, our engineers will work with you to devise the ideal solution.

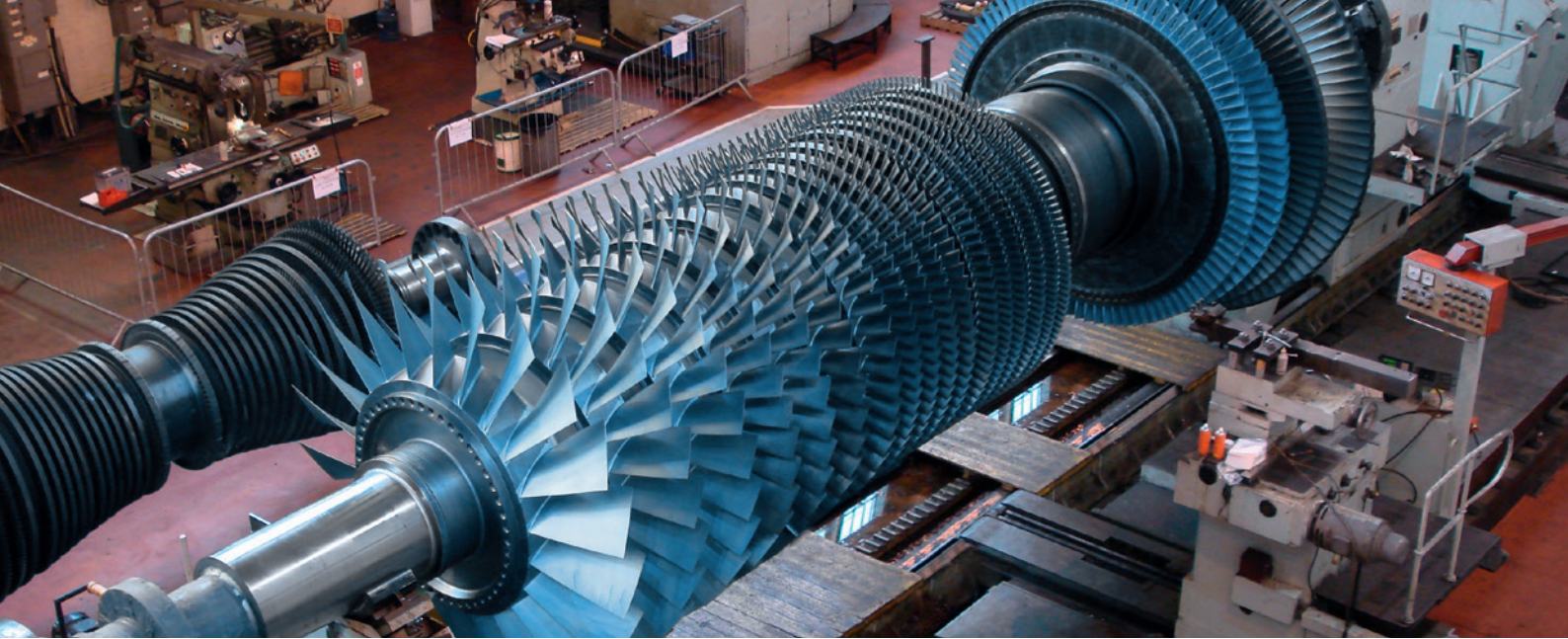
OIL AND GAS – OFFSHORE AND ONSHORE INSTALLATIONS



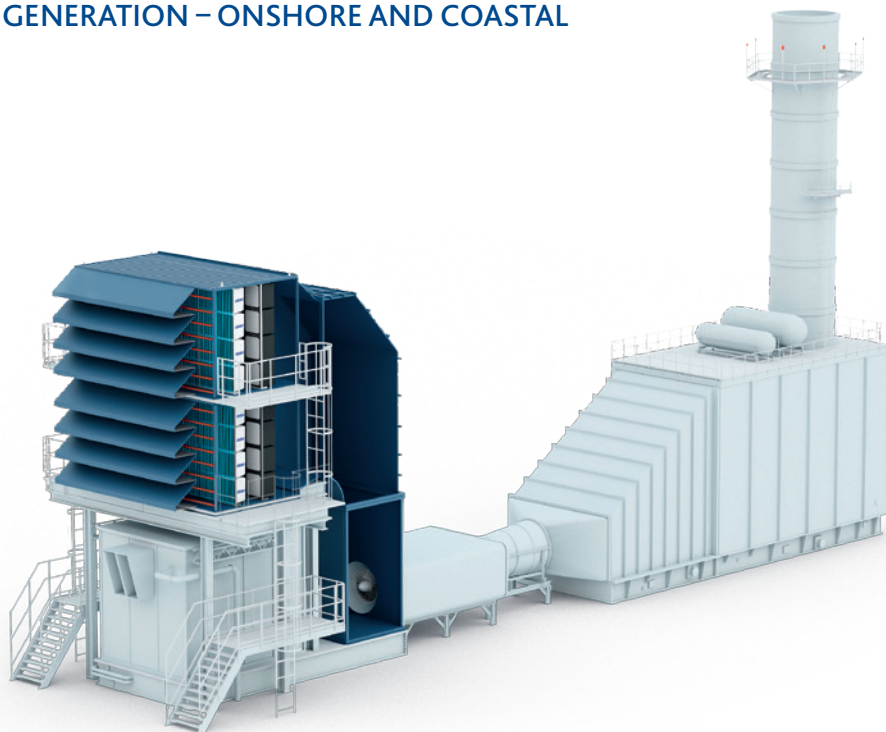
Oil and gas production often takes place in extremely harsh environments. Typical filtration challenges include heavy fog, salt spray, air pollution from other sources or very high dust concentrations. These conditions are frequently made worse by the by-products of drilling and industrial contaminants like hydrocarbons.

Freudenberg core strengths

- Solutions tailored to meet any operational conditions, including desert, arctic and tropical
- Systems built around the optimum combination of filter types and classes
- Water / salt removal avoids corrosion in compressor and hot sections
- Long filter life and excellent total cost of ownership (TCO)
- On-site technical support and aftersales service



POWER GENERATION – ONSHORE AND COASTAL



The power generation industry and the customers who depend on an uninterrupted power supply require extremely high levels of reliability. Freudenberg system solutions are ideally suited to these demands. The exceptional quality and performance of our filters protects turbines from fouling, improves availability, extends maintenance schedules and makes a major contribution to avoiding unplanned downtime.

Freudenberg core strengths

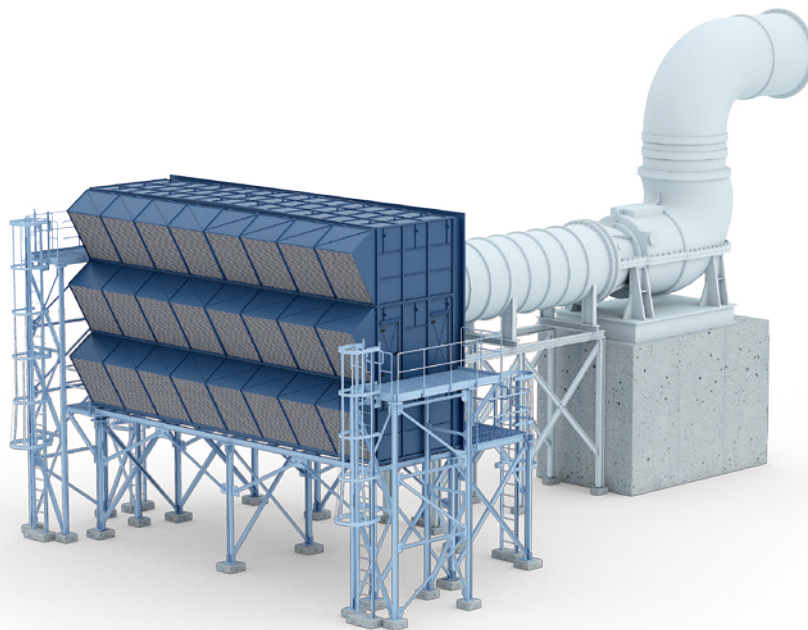
- Customized solutions for any operational conditions
- Exceptional filter performance for high reliability and low TCO
- Filtration systems up to EPA purity levels eliminate fouling of turbine blades
- High dust-holding properties maximize filter life time and reduce costs
- Full program of filters, spare parts and special accessories

SECTOR-SPECIFIC EXPERTISE

INDIVIDUALLY DESIGNED SOLUTIONS FOR SPECIFIC INDIVIDUAL PROCESSES

Over 60 years of experience as a world leader in air filtration has given us the technical and practical knowledge to design high-performance solutions for every conceivable industrial application. Regardless of where of what your challenge might be.

COMPRESSORS



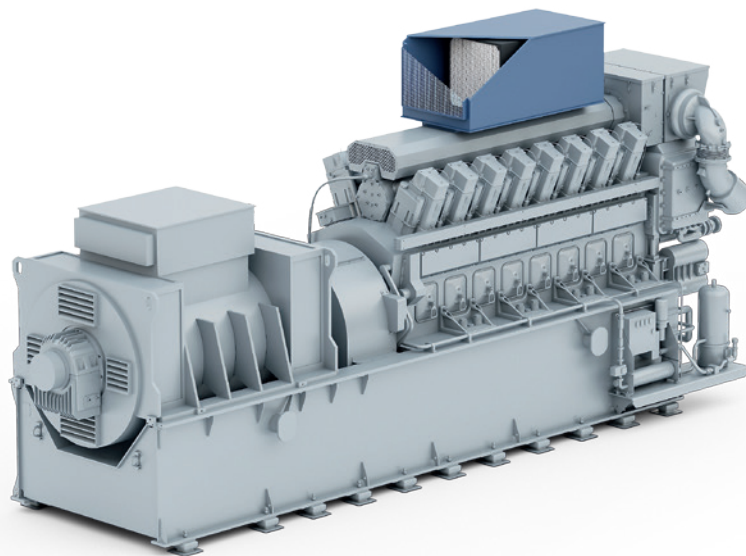
Supporting a huge range of industrial functions, compressors rely heavily on filter quality to ensure their efficiency. This is especially true of air separation plants, which often need to be operational for periods as long as 12 or 24 months without ever shutting down. This means that the specified filtration solution has to be 100% reliable, with a ready supply of spares and simple filter exchange processes.

Freudenberg core strengths

- Long-lasting filters with extremely high dust-holding capacities
- Filters with special features such as water droplet separation
- Fully customizable solutions
- Optimum protection of compressor blades during 24/7 operation
- Outstanding filtration efficiency for maximum availability and return on investment (ROI)



DIESEL AND GAS ENGINES



Diesel and gas engines are used in countless industrial applications. The wide variety of engines in use means that air filtration solutions ideally need to be specifically designed for each application. With our comprehensive range of filters, accessories and mounting systems, Freudenberg can provide the ideal cost-effective solution for any diesel or gas engine.

Freudenberg core strengths

- Long-lasting filters with extremely high dust-holding capacities
- Flexible design solutions that match the precise needs of the engine
- Long-term supply agreements or partnerships from a global player with more than 160 years of history

FREUDENBERG'S MULTI-STAGE FILTRATION CONCEPT

PERFORMANCE-OPTIMIZED TO MEET SPECIFIC OPERATIONAL CONDITIONS

Multi-stage filtration systems provide more effective filtration and increased protection for turbines and compressors. This has the effect of minimizing the risk of damage due to fouling. It also helps to eliminate unplanned downtime, reduce general maintenance costs and ensure that the turbine is running at optimum efficiency.

In a 2-stage system, the cassette filter in the final stage is protected by an upstream pocket filter. A 3-stage system adds a further downstream cassette filter stage. This can provide filtration levels up to EPA standard. The choice of filters for each stage depends heavily on the environmental conditions around the plant, as well as on any space limitations.

Getting the right solution for your needs

Freudenberg's extensive experience of system solution design for hundreds of different applications worldwide is especially valuable in ensuring that your plant is correctly specified. Discover how efficient your filtration system is and ask for a calculation with Freudenberg's proprietary e.FFECT software.

e.FFECT

electronic Freudenberg Filter Efficiency Calculation Tool

Your benefits at a glance

Our multi-stage air filtration concept offers tangible performance, efficiency and profitability:

- Customized systems to meet your specific needs
- Expert advice and guidance on system design, construction, commissioning and maintenance
- Wide choice of filter products for a perfectly balanced solution
- Low pressure drop with outstanding particle collection efficiency
- Superior working life and longer maintenance intervals
- High quality filter products help to eliminate unplanned downtime
- Maximized performance leads to optimum Return on Investment



Ideal for highest-purity with EPA filtration: 3-stage with compact pocket, MaxiPleat and eMaxx cassette filters



Ideal for restricted spaces: MaxiPleat modular filter system featuring a 2-in-1 concept



Ideal for preventing water ingress: hydroMaxx-coalescer pocket filter with eMaxx cassette filter



Optimized for cleanable filters and a safety filter stage: Pulse-jet cartridges + MaxiPleat cassette filter

TYPICAL FILTER PRODUCTS USED IN FILTRATION SOLUTIONS FOR GAS TURBINES AND COMPRESSORS

Freudenberg Filtration Technologies offers a comprehensive range of cassette filters, pocket filters and cartridge filters for all turbomachinery and compressor air filtration systems, no matter where they are located or what the climatic or environmental conditions may be. In addition,

we have the products required to support the growing trend for the use of EPA filter systems, covering filter classes from ISO ePM1 $\geq 95\%$ (to ISO 16890) up to E12 (to EN 1822).

VILEDON HYDROMAXX COALESCER PREFILTERS

- Water repellent with “front of filter” drainage effect in reverse fit configuration.
- Offer excellent coalescing properties.
- Ideally suited for applications where filters are exposed to constant water spray or fog.



VILEDON POCKET FILTERS COMPACT T 60 AND T 90

- High-performing, economical and energy efficient.
- Cost-efficient T60/90 compact pocket filters are resilient in continuous operation and achieve superlative performance based on high clean-air quality.



VILEDON EMAXX AND MVPGT CASSETTE FILTERS

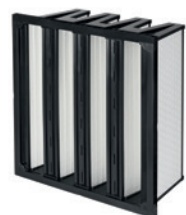
eMaxx

- Excellent dust holding capacity thanks to 420 mm depth of the filter element which implies salient durability for a long service life.
- Powerful, efficient and resilient, even in damp or wet conditions.



MVPGT / MVPGT-21 / MVPGT-30

- Features at an optimal price-performance ratio. Highly efficient with 21 m² and 30 m² filter surface.



VILEDON MAXIPLEAT CASSETTE FILTERS

- Optimized handling, functional reliability and economy combined with uncompromising high filtration quality up to EPA purity level.
- High security against dust penetration, outstanding bursting strength.
- Optional water barrier for less water-carry-through.
- 2-in-1 MaxiPleat Modular Filter System for constricted space.



VILEDON FILTER CARTRIDGES OF GTS, GTB AND GTG SERIES

Pulsable variants of GTS and GTB series

- Optimized self-cleaning characteristics for maximized useful lifetimes.
- Field-proven for critical on-site conditions like desert areas or tropical climates with high relative humidity.
- GTS: tested acc. to ARAMCO specification.



Static variants of GTG series

- Optimal pressure drop characteristics resulting in maximized useful lifetimes for enhanced cost-efficiency of turbomachinery systems.

Various 2-in-1 filtration system solutions based on Freudenberg's unique modular clip-on system. Ask our filter experts for explanation.



COMPLETE FILTER HOUSING CONSTRUCTION

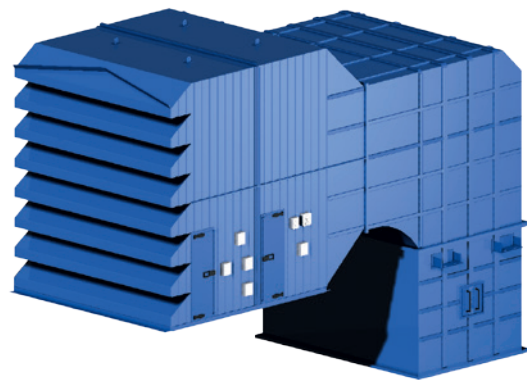
ACCURATE PLANNING, CUSTOMIZED SOLUTIONS, LONG-TERM SUCCESS

Freudenberg Engineering

Freudenberg Engineering provides a comprehensive development and installation program for the retrofitting or new construction of air filter systems. Our individually specified service packages include on-site status analyses, consultancy, system design, quotations using 3D-CAD drawings, technical economic analysis, complete order handling, documentation, training and aftersales service.

We have extensive global experience in air filtration engineering solutions for gas turbines and compressors. Our references include numerous examples of air filter systems for co-generation power stations, compressor stations, air separation plants and other industrial and commercial applications.

Freudenberg engineering teams are based worldwide and work closely with our customers to provide efficient solutions, regardless of the size and scale of the project. Every system is customized to meet the requirements of each specific application.



Our engineering portfolio at a glance

- Comprehensive status quo analysis
- 3D CAD models
- CFD analysis
- Structural calculation and FEM analysis
- Customized filtration solutions
- Small to large turn-key installations
- Final on-site inspections
- Close coordination with our customers
- Filter house production with qualified partners
- Continuous quality control

ENGINEERING SERVICES AT A GLANCE

Construction:

- New construction
- Replacements
- Retrofit of steel and concrete filter housings
- Upgraded filter solutions

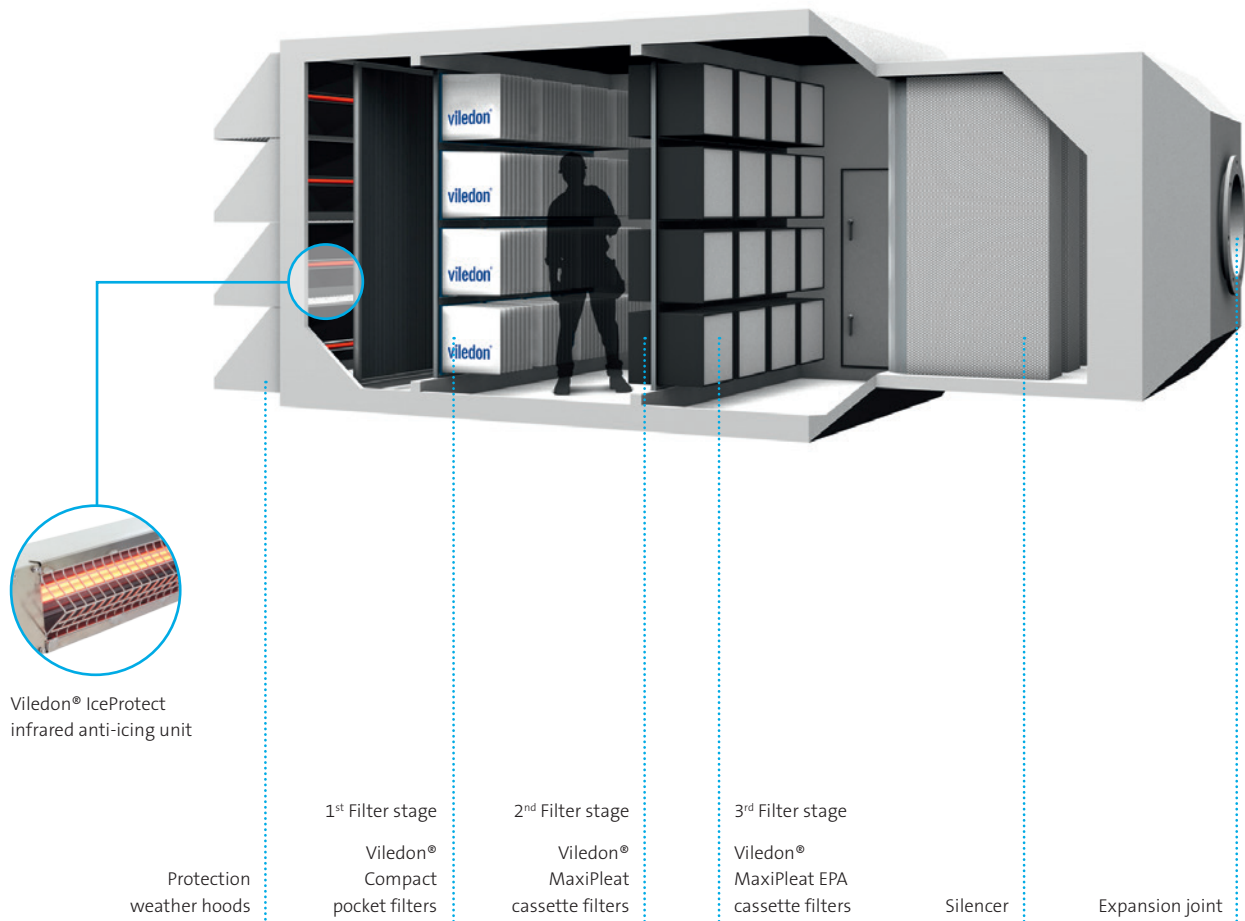
Components:

- Single- or multi-stage Viledon® filter walls
- Weather hood constructions
- Weather louvres
- Measuring instruments
- Infrared anti-icing systems
- By-pass flaps
- Heat exchanger
- Air ventilation ducts
- Air cooling systems (Viledon® eee.Sy)
- Droplet separators
- Fans
- Transition ducts and elbows
- Electrical equipment
- Shut-off louvres
- Silencers
- Support construction
- Insulation

WALK-IN FILTER HOUSE

A typical walk-in filter house showing a compact 3-stage configuration.

Thanks to the MaxiPleat modular system, different filter classes and depths can be combined by simply clipping them together. This saves space and allows an additional filter stage to be added without any structural modifications.



PROVEN SUCCESS IN THE MOST DEMANDING ENVIRONMENTS

A SMALL SAMPLE OF PROJECTS SUCCESSFULLY COMPLETED INVOLVING GAS TURBINES AND COMPRESSORS

19 COMPLETE INTAKE AIR SYSTEMS FOR 5 OFFSHORE PLATFORMS



Freudenberg was tasked with designing, building and installing a series of multi-stage air filtration plants for five new offshore platforms, owned and operated by the Brazilian state oil company. The big challenge was the predominantly moist salt air.

To cope with the harsh operating environment, we built the filter houses from stainless steel and painted them to resist corrosion. We also installed weather hoods and droplet separators to keep rain and salt-spray away from the filters. Result: outstanding filtration, long filter life time and reduced costs.

Key data

- Location: Brazil, offshore
- Gas turbine: Rolls Royce RB 211/19 (4 extraction / processing platforms with each 4 units + 1 drilling platform with 3 units)
- Power output: 25 MW each

Solution

- Multi-stage filter systems with weather hoods
- Filter houses made of stainless steel

MODIFICATION TO A 3-STAGE FILTRATION SYSTEM IN A MALAYSIAN POWER STATION



This project involved converting the air intake housing of a large power station from a cartridge to a static filter system. The existing solution could not cope with sticky dust in the highly polluted ambient air, resulting in poor compressor performance, high heat rate and high operating costs.

Freudenberg's multi-stage filtration solution involved the construction of new filter walls and a modular filter system. The results included perfect compressor cleanliness, long filter life time, reduced service intervals and vastly improved control of pressure difference.

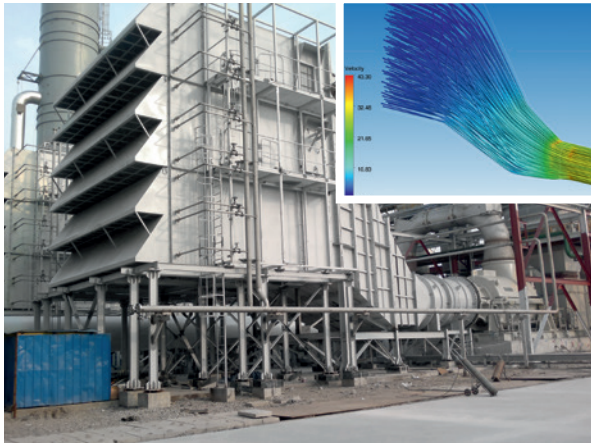
Key data

- Location: Malaysia, Penang
- Gas turbine: GE Frame 9FA
- Power output: 350 MW

Solution

- Replacement of the complete filter walls; new holding frames
- Instead of 2 stages, a new 3-stage filter system with reliable prefiltration and a 2-in-1 fine filter stage
- Upgrade to EPA filtration level

INTAKE AIR SYSTEMS FOR LARGE TURBO COMPRESSORS IN CHINA



The project task was: design, building and installation of two complete air intake systems for large turbo compressors of a petrochemical plant. Restricted space combined with an unusual site configuration proved to be a real challenge for Freudenberg's engineers.

Besides a 2-stage filtration concept, individual shut-off louvers with an electrical drive for online filter exchange have been installed. The pressure drop has been optimized by a Freudenberg in-house made CFD calculation which lead to the extraordinary design of the transition section between filter house and compressor.

Key data

- Location: Tianjin, China
- Compressors: 2 Siemens STC-SX (450-6V6)

Solution

- Two filter houses with transition section, individual shut off louvers plus electrical drive for online filter exchange and with surge and implosion doors
- 2-stage filtration system with each 195 pieces of pocket and cassette filters and upstream anti-icing with hot water heat exchanger

LARGE POWER STATION IN MIDDLE EAST WITH UPGRADE TO GTS CARTRIDGES



Air filtration in coastal desert environments has to cope with extreme ambient heat as well as high humidity and dust levels. Freudenberg was asked to provide a solution that significantly improved on the inefficiency and high cost of the existing system.

Key data

- Location: Oman, near the coast in a desert environment
- Gas turbine: GE Frame 9E
- Power output: 120 MW

Solution

- Installation of GTS 445-324 cartridge sets (conical /cylindrical)



Simply visit the link for more references:

www.freudenberg-filter.com/references/gt



Freudenberg Filtration Technologies SE & Co. KG
69465 Weinheim, Germany
Phone +49 (0) 6201 80-6264 | Fax +49 (0) 6201 88-6299
viledon@freudenberg-filter.com | www.freudenberg-filter.com

