aigner®

TUNNEL TECHNOLOGY

TUNNELS FOR THE FUTURE
CLEAN & SAFE

HEALTHY CLIMATE • CLEAN TUNNELS

www.aigner-tunnel.com

INTENSIVE RESEARCH

As early as 1990 we started development and construction of electrostatic filters for exhaust gas removal in road tunnels. In 2000, our completely novel ECCO filter design was patented.

In intensive cooperation with the Graz University of Technology and other Austrian research institutions, we were successful in continuously developing further our filter system. With ECCO*EP* and ECCO*HYBRID*, today we are the only vendor of different filter solutions which are all specifically adapted to the special requirements in road tunnels.

As a positive confirmation of our work, for the development of the ECCO filter design we were awarded the Innovation Prize of the State of Upper Austria.

IN ACTION

Our success is also reflected by the fact that we have advanced to become today's European market leader. In virtually all recently realized projects, the tunnel operators placed their trust in us.

1991: Plabutschtunnel, Austria (experimental system)
1994: Katschbergtunnel, Austria (experimental system)
2002: Plabutschtunnel, Austria (pilot project)
2005: Wienerwaldtunnel, Austria (ECCO*DUST*)
2006: Cesena, Le Vigne Tunnel, Italy (ECCO)
2007: Madrid, Calle 30, Spain (ECCO + ECCO*NOxCAT*)
2008: Tunnel Kirchdorf, Austria (ECCO*DUST* against asbestos)
2008: Tunnel Neapel-Pozzano, Italy (ECCO)
2009: Roppener Tunnel, Austria (FIRE*CURTAINS*)
2010: Mont Blanc-Tunnel, France (ECCO*EP*) NEW

„In urban agglomerations, the ever-increasing traffic threatens to become an even greater burden on people and environment. Today all over the world giant tunnel projects are being planned or already built to prevent collapse of transportation. With our ECCO filter systems we can contribute to maintain a healthy living space for the abutters.

In the future, use of tunnel filters might even become a prerequisite for tunnel projects to be approved and realized in the first place.

Protecting people and environment, that is our mission!“

Ing. Heinz Aigner
Managing Director

GLOBALLY LEADING
TUNNEL FILTER SYSTEMS

Filter systems for tunnels are subject to particular, very special requirements. In the interest of our customers, we offer sophisticated ready-to-use systems which we are continuously optimizing with regard to an economic solution.

Here we place particular emphasis on:

- As low place requirements as possible
- High efficiency
- Low energy consumption

TUNNEL TECHNOLOGY

DUST FILTERS FOR ROAD TUNNELS • PAGE 4
ECCO • ECCO*HYBRID* • ECCO*EP*

GAS FILTERS FOR ROAD TUNNELS • PAGE 14
ECCO*NOxCAT*

DUST FILTERS IN TUNNELS UNDER CONSTRUCTION • PAGE 16
ECCO*DUST* • Mobile Filtration Units

SAFETY FOR ROAD TUNNELS • PAGE 20
FIRE*CURTAINS*

SERVICES
PAGE 24
Engineering • Installation • Maintenance

REFERENCE PROJECTS
PAGE 25
Building Sites Worldwide

FREE OF PARTICULATE MATTER!
THAT MATTERS

Our active contribution to environment protection and for clean air

aigner®

TUNNEL TECHNOLOGY

ECCO-FILTER-SYSTEMS

Time and again, tunnel constructions in densely populated areas attract public attention. During the regular operations of road tunnels, emissions of particulate matter are caused by minute, carcinogenic diesel soot particles, wear debris of tyres, brake disks, clutches and road paving which usually have a diameter as small as 0.1 µm or even less. With few exceptions, today exhaust air from road tunnels is discharged through a flue without filtering and in concentrated form. This burden on the environment and hazard to our health can now be avoided by using the patented ECCO filter system. ECCO is the result of forceful research and development work. High efficiency makes it possible to reduce particulate matter load and to intercept carcinogenic diesel soot particles.

PARTICULATE MATTER IS DANGEROUS

Recent research results show: The smaller the particles, the more dangerous they are, since they may penetrate deeply into the respiratory system and even into the brain. ECCO filter systems create safety for your health!

MAGISTERIAL APPROVAL

Approval of new tunnel projects in metropolitan agglomerations usually entails rigid environment compatibility assessments where very much attention is paid to the abutters‘ interests. Over the last years, some projects could be implemented only by using state-of-the-art technology… many of them with the patented ECCO filter system.

PM10 TODAY. PM2.5 TOMORROW

In large cities, even today the international standards for permissible excesses of particulate matter concentration can be hardly complied with. These minute particles are so dangerous that from 2015 onward PM2.5 shall be the legally allowed limit value.

It is probable that in the foreseeable future with PM1.0 even more rigid standards shall enter into force.

The ECCO filter system creates ideal conditions, by actually complying today with the limit values of tomorrow.

EXHAUST AIR OR BY-PASS

The ECCO filter system can be used in any tunnel project, no matter whether it is about new construction or refitting during renovation.

ECCO filters can be used as plain exhaust air filters or for feeding back the cleaned air into the tunnel (by-pass system). Each ECCO filter system is custom-made and tailored to the special local requirements.

UNIQUE: CHOOSE FROM AMONG 3 SYSTEMS

Each tunnel project is unique and has its distinctive features. We are the only vendor offering, in order to meet these requirements, three different versions of tunnel dust filter for different applications: ECCO, ECCO*HYBRID* und ECCO*EP*.

SMALL BUT WITH IMPACT

Particle size	<0.5 µm	0.5-1.0 µm	1.0-10 µm	>10 µm
Numbers	95.3 %	4.3 %	0.4 %	0.0 %
Mass	38.1 %	9.0 %	50.9 %	2.1 %

Particle distribution Plabutschtunnel Graz (Austria):
January – April 2009

97 % below 0.5 µm

Hazardous particles are specifically removed before the end of the tunnel ①, so they cannot escape into the open.

Purification is done in the ECCO filter modules ②. For fire emergencies, a by-pass with automatic dampers ③ is installed between the modules. The purified tunnel air is blown out through an exhaust gas stack ④.

The technical room ⑤ comprises all necessary aggregates such as high voltage power supply, filter cleaning, water treatment and electric control.

MODE OF OPERATION

Ionizer: sawtooth-shaped ionizer blades ①, situated between grounded electrodes ② create a strong electrostatic field charging the dust particles ③ in the airflow.

Filter media: The ECCO filter system is unique in its use of a special filter media ⑤ which is likewise arranged between high voltage grids ④ and thus in an electrostatic field. Thus, even the smallest dust particles can be intercepted with optimum efficiency.

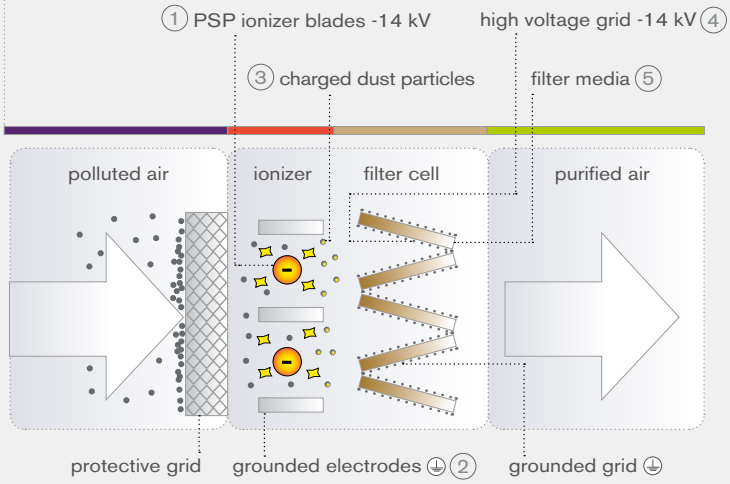
Dry cleaning: The ionizer is wet-cleaned, but the filter media where the dust is separated can be dry-cleaned. To this end, the dust is aspirated from the filter media and collected into dust bins or Big Bags in a separate filter system and can thus be disposed of very easily. Of course, cleaning of the ECCO filter system is performed fully automatically.

DISTINCTION

The distinguishing feature of this filter is the combination of electrostatic charge with a filter media for mechanical separation of dust particles.

Here in a first step the particles are electrostatically charged in the ionizer section and subsequently separated in the filter media which can then be dry-cleaned.

ECCO



IntelligentCleaning

In all ECCO filters, cleaning is also ultramodern and unique. Rather than following rigid cleaning cycles, the ECCO filter system decides independently when the ideal time has come for cleaning the filter media. IntelligentCleaning means that the system continuously adapts to the current traffic and operating conditions.

Here the following parameters are considered, each of which may trigger cleaning at the ideal time point:

- Operating hours
- High voltage current
- Pressure losses
- Fixed time interval

FIELDS OF APPLICATION

Filters for larger dust particles and high dust concentrations

ADVANTAGES

Benefit from ultramodern technology with the patented ECCO filter system!

Particle size and efficiency

- For all particle sizes from 0.1 – 50 µm thanks to use of a special filter media
- Optimum efficiency for all particle sizes and ultrafine particles below 0.1 µm
- Reliable separation thanks to filter media

Top material quality

- All parts in contact with the medium are made of robust and long-life stainless steel
- Corrugated isolators with nanocoating for easy cleaning and shorter drying times

Operating costs and cleaning

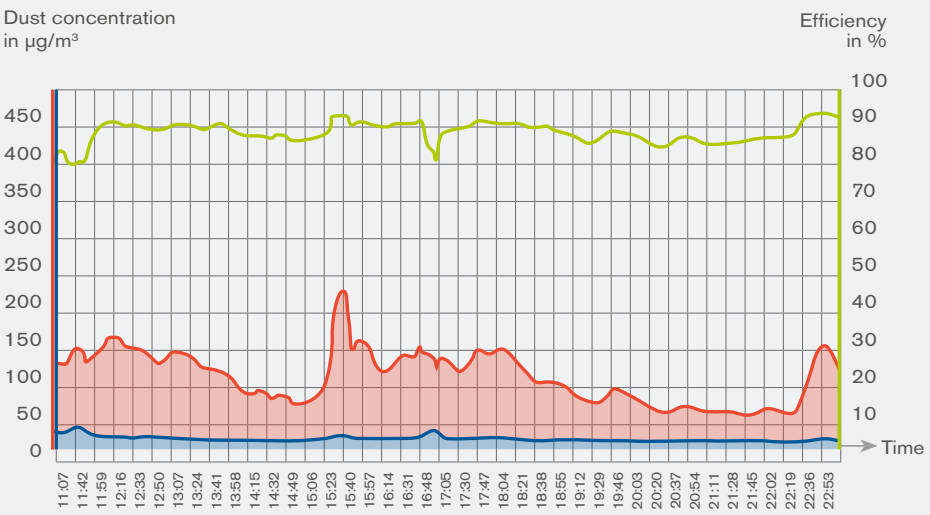
- Specific optimization for saving operation and maintenance costs
- Maintenance fast and simple
- Simple water treatment with belt filters
- Simple dust disposal with dust bins or Big Bags

TECHNICAL DATA

High Voltage:	-14	kV
ECCO filter unit:		
• Airflow	40	m³/s
• Width	3,800	mm
• Height	2,400	mm
• Pressure loss	250	Pa
• Power consumption	2.2	kW
• Stainless steel	1.4301	AISI 304
• maintenance platform: zinc coated or stainless steel		

ECCO

Efficiency measured in Madrid (Spain), Calle 30, By-pass Tunnel, Ventilation section PV3: 30th August 2007



- Total Suspended Particles TSP upstream filter in µg/m³
- Total Suspended Particles TSP downstream filter in µg/m³
- Efficiency in % at 100 % airflow

EFFICIENCY CHART

The typical variation of particle concentrat on over the day, depending on traffic load.

MODE OF OPERATION

Electrostatic filter cell – ionizer and collector: The ionizer comprises sawtooth-shaped ionizer blades ① situated between grounded electrodes ②. These create a strong electrostatic field charging the dust particles in the airflow.

In the ECCO*HYBRID*, a part of the dust particles is already removed in the collector of the electrostatic filter cell. The charged particles ③ are repelled by the high voltage plates ④ and adhere to the grounded collector plates ⑤.

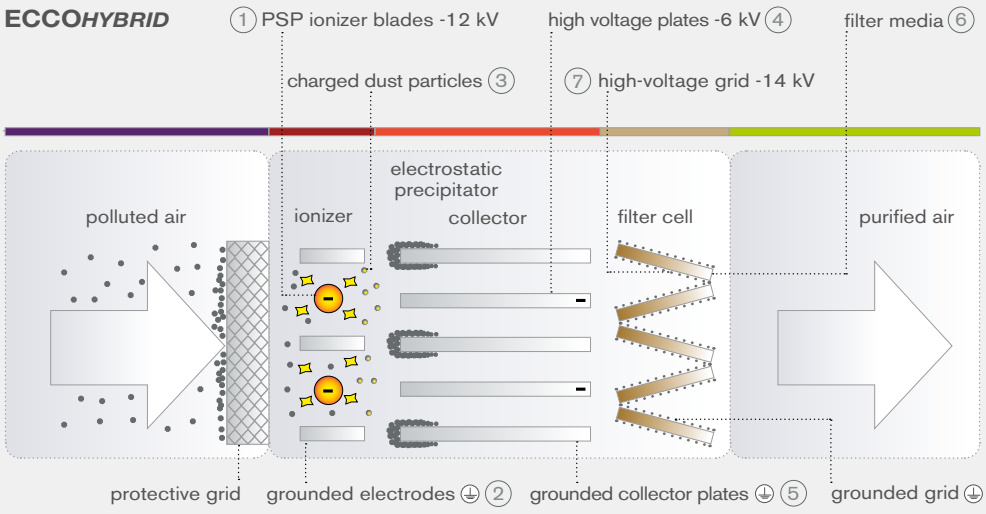
Filter media: As in the ECCO, the filter media ⑥ is arranged between high voltage grids ⑦ and thus in an electrostatic field. Pre-precipitation in the electrostatic filter cell markedly increases the life time of the filter media.

Cleaning: Cleaning of the electrostatic filter cell is done using an automatic, oscillating wash system and connected water treatment. The purified water may be discharged into the sewage system or recycled. Here, too, the filter media is dry-cleaned.

DISTINCTION

As in the ECCO, in the ECCO*HYBRID* in a first step the dust particles are charged electrostatically in the ionizer section.

Then, however, the particles are precipitated at two points, namely in the electrostatic filter cell and on the other hand in the filter media itself, as in the ECCO.



FIELDS OF APPLICATION

Higher efficiency for ultrafine particles, particularly with reduced airflow

ADVANTAGES

Benefit from ultramodern technology with the patented ECCO filter system!

NEW: Particle size and efficiency

- For all particle sizes from 0.1 – 50 µm thanks to use of a special filter media
- Optimum efficiency for all particle sizes and ultrafine particles below 0.1 µm, particularly with reduced airflow
- Reliable separation thanks to filter media

Top material quality

- All parts in contact with the medium are made of robust and long-life stainless steel
- Corrugated isolators with nanocoating for easy cleaning and shorter drying times

Operating costs and cleaning

- Lower dust load of the filter media by additional use of an electrostatic filter cell
- Improved life time and longer service intervals compared to ECCO
- Specific optimization for saving operation and maintenance costs
- Maintenance fast and simple
- Oscillating wash system increases the cleaning effect of the electrostatic filter cell
- Water treatment for waste water operations or recycling
- Simple dust disposal with dust bins or Big Bags

TECHNICAL DATA

High Voltage:

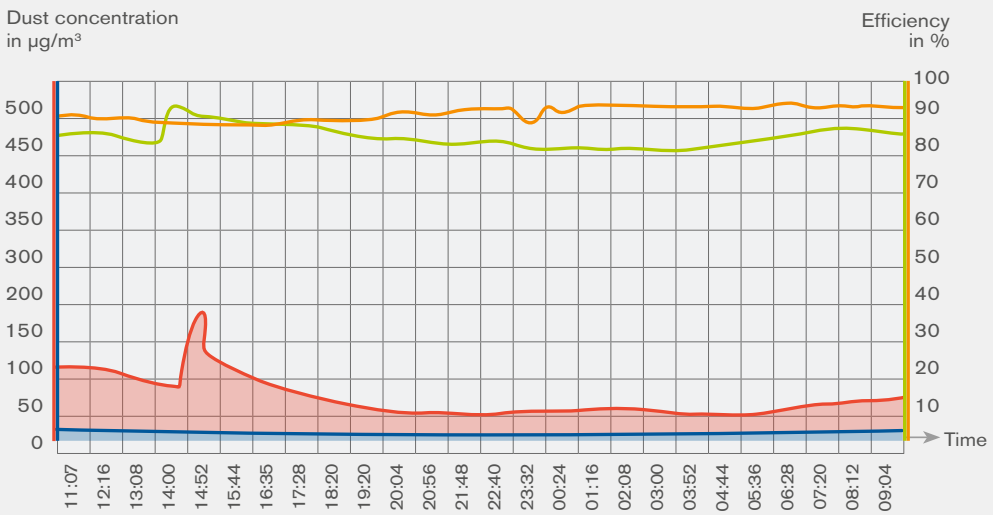
• Ionizer	-12	kV
• Collector	-6	kV
• Filter media	-12	kV

ECCO*HYBRID*-unit:

• Airflow	40	m³/s
• Width	3,800	mm
• Height	2,400	mm
• Pressure loss	250	Pa
• Power consumption	1.2	kW
• Stainless steel	1.4301	AISI 304
• maintenance platform: zinc coated or stainless steel		

ECCO*HYBRID*

Efficiency measured in Graz (Austria), Plabutschtunnel: 21st – 22nd March 2008



- Total Suspended Particles TSP upstream filter in µg/m³
- Total Suspended Particles TSP downstream filter in µg/m³
- Efficiency in % at 100 % airflow
- Efficiency in % at 50 % airflow

EFFICIENCY CHART

Many systems are mostly running with less airflow. The diagram shows the efficiency with reduced airflow.

MODE OF OPERATION

In the ECCO*EP*, too, the dust particles are first charged electrostatically in the ionizer section ①, then repelled by the parallel-mounted high voltage plates ④ and removed at the grounding plates ⑤. In order to further increase efficiency, in the ECCO*EP* we have arranged two electrostatic filter cells serially, making the highest degrees of precipitation possible.

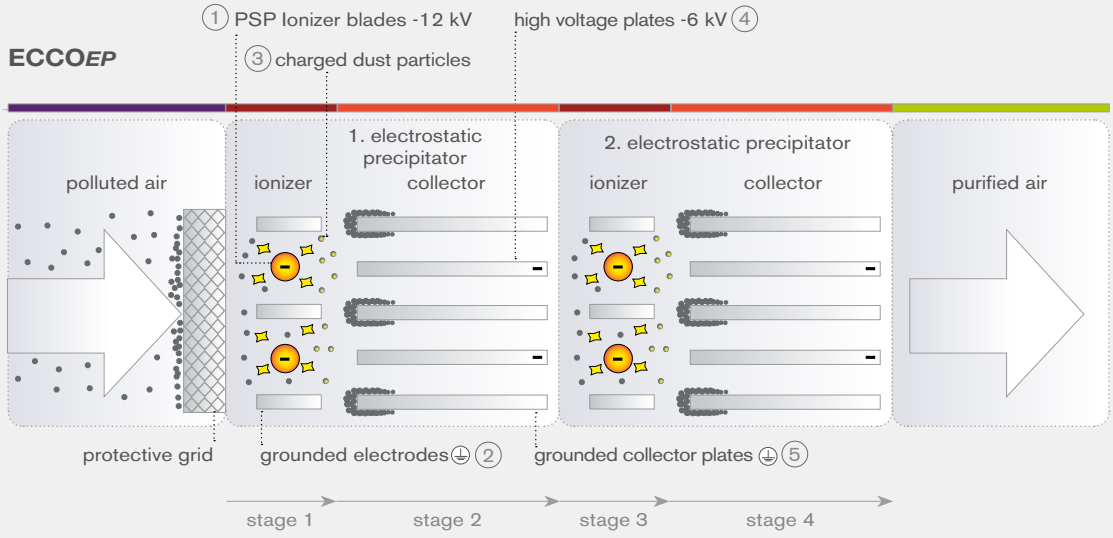
4-stage filter system: In the 1st stage, sawtooth-shaped ionizer blades ①, arranged between grounded electrodes ②, generate a strong electrostatic field where the dust particles ③ are charged in the airflow. A part of these particles adheres to the grounded collector plates ⑤ (2nd stage) and is already removed in the first electrostatic filter cell. Subsequently, in the second electrostatic filter cell the remaining dust particles are charged or ionized once more (3rd stage) and completely removed in the second collector (4th stage).

Cleaning with oscillating wash nozzles: Cleaning of the electrostatic filter cells is done using a fully automatic wash system with flat beam nozzles and an oscillating wash system. Thus the cleaning effect is much better than with rigid nozzle systems with lower water pressure at the collector plates.

For the ECCO*EP*, this results in optimized cleaning with comparably low water consumption.

DISTINCTION

The new ECCO*EP* – the new generation of filter technology! Even more space-saving and with even lower pressure loss and energy consumption than the ECCO*HYBRID*. Highest efficiency thanks to a 4-stage filter process! Moreover specially designed for use under conditions of particularly high humidity!!



FIELDS OF APPLICATION

Particularly well suited, thanks to the special design, for use under conditions of high humidity and with road salt in winter, as well as for special requirements for precipitation of ultrafine particles

ADVANTAGES

With the ECCO*EP* we have taken our patented ECCO filter system yet another step further. Find for yourself the advantages of the new ECCO*EP*!

NEW: Particle size and efficiency

- For all particle sizes from 0.1 – 20 µm
- Efficiency further increased (up to 98 %) for all particle sizes and ultrafine particles below 0.1 µm, particularly with reduced airflow

Top material quality

- All parts in contact with the medium are made of robust and long-life stainless steel
- Corrugated isolators with nanocoating for easy cleaning and shorter drying times
- New, modular framework for precise installation on-site, facilitates and accelerates installation

Operating costs and cleaning

- Specific optimization for saving operation and maintenance costs
- Maintenance fast and simple
- Ionizing blades detachable separately or as a whole without disassembly of the filter cell
- Oscillating wash system increases the cleaning effect
- Water treatment for waste water operations or recycling
- Simple dust disposal with dust bins or Big Bags

TECHNICAL DATA

High Voltage:

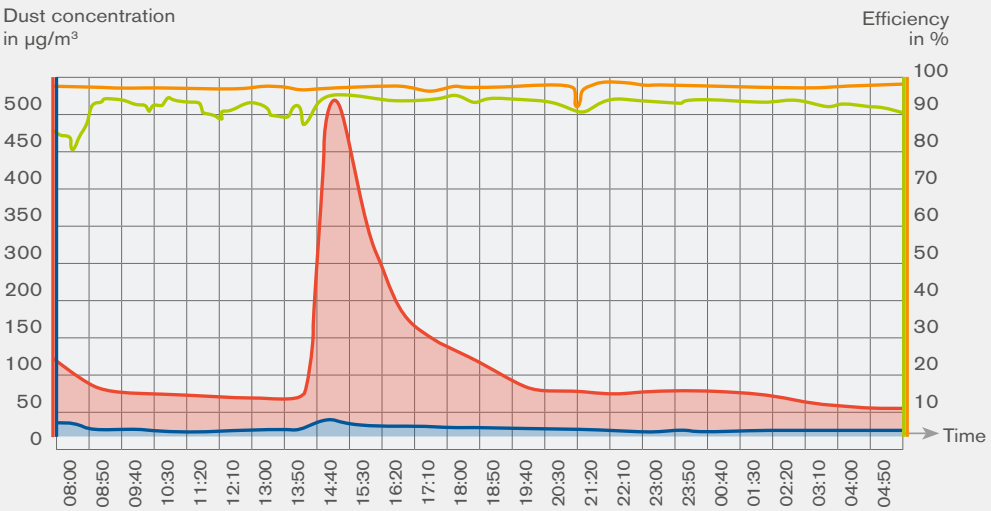
• Ionizer	-12	kV
• Collector	-6	kV

ECCO*EP*-unit:

• Airflow	30	m³/s
• Width	2,606	mm
• Height	2,543	mm
• Pressure loss	160	Pa
• Power consumption	1.6	kW
• Stainless steel	1.4301	AISI 304
• maintenance platform: zinc coated or stainless steel		

ECCO*EP*

Efficiency measured in Graz (Austria), Plabutschtunnel: 16th – 17th December 2008



- Total Suspended Particles TSP upstream filter in µg/m³
- Total Suspended Particles TSP downstream filter in µg/m³
- Efficiency in % at 100 % airflow
- Efficiency in % at 50 % airflow

EFFICIENCY CHART

The diagram shows the improved efficiency up to 98 % with reduced airflow.

EQUIPMENT FOR ECCO DUST FILTERS

We offer comprehensive equipment for our systems. For detailed questions, please contact us!

HIGH-VOLTAGE POWER SUPPLY

HIGH-VOLTAGE TRANSFORMERS

- Hermetically sealed, maintenance-free high-voltage transformers
- Secondary coils in foil technology
- Compact primary choke coil dimensioned for nominal short circuit current
- High voltage rectifier dimensioned for 2× the peak-to-peak amplitude of open-circuit voltage
- Oil tank with temperature and pressure sensors, oil level control and safety valve

- Voltage supply 400 V / 50 Hz
- High voltage: 12/6 oder 14 kV / negativ

HIGH-VOLTAGE CONTROL

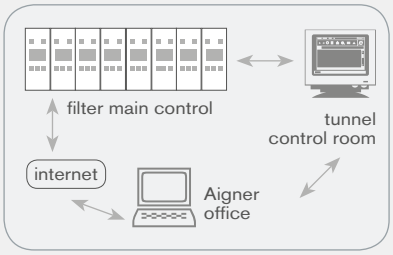
- Profibus DP interface for connection to visualizations and control systems with PLC controllers
- Remote control via Bus Master
- Real-time measurement and Fuzzy Logic
- Automatic voltage control of maximum current and to avoid short circuits

SAFETY SYSTEMS FOR HIGH-VOLTAGE INTERRUPTION

- Key system to prevent that high-voltage rooms can be entered without authorization
- Manual grounding connects high voltage and grounding. Thus it is not possible to enter the high-voltage circuit while there is manual grounding
- All safety systems are particularly important for maintenance work to guarantee the safety of the staff

ELECTRICAL CONTROL SYSTEM

- System control designed for clear and simple operations
- Monitoring of the complete system via central control cabinet
- Connection to the tunnel control centre is possible and recommended to log all necessary and important information



OFFICE CONTROL

- For support during operations and maintenance
- Via internet, we can query all important parameters and also adapt them to changed conditions if required
- Saves time and money for tunnel operators and ensures perfect long-term functioning of the facilities

EQUIPMENT FOR ECCO DUST FILTERS

WASTE DUST HANDLING

DUST FILTRATION

- For dry-cleaning of ECCO and ECCO*HYBRID*
- Particle filter system with fully automatic cleaning using pressurized air
- With all necessary system components such as fans, compressors for pressurized air, controls, etc. included

MONITORING

PARTICLE MEASUREMENT

Continuous measuring of dust particle concentrations up- and downstream the filter

- Based on the principle of laser light scattering measurement
- Determination of particle number and size
- Display of number of particles, mass concentration in µg/m³ and PM10, PM2.5, PM1.0
- Software for data evaluation and data logging
- Integrated into our control system with remote monitoring via internet

NO AND NO_2 MEASUREMENT

Continuous measuring of NO and NO_2 concentrations up- and downstream the filter

- Special sensors without any maintenance

WATER TREATMENT

WATER TREATMENT

Depending on magisterial requirements, we offer different types of water treatment:

- Waste water: Automatic belt filter with coagulation, pH controller and control
- Recycling: Automatic cartridge filters with pressurized air regeneration for recirculation and reuse for the cleaning of ECCO system
- Tanks for clean water and waste water

TURNKEY SERVICES

TURNKEY SERVICES

We provide all necessary equipment required for operating an ECCO filter system: Compressors, fans, maintenance platforms, etc.
Furthermore we also supply the complete mechanical and electrical installation

COMMISSIONING AND TRAINING

- Commissioning of the complete plant with training for your staff
- By request we offer training programs to run the plant correctly

aigner®

TUNNEL TECHNOLOGY

TAKE A DEEP BREATH: ECCONOxCAT

Road traffic is one of the main reasons for nitrogen oxide pollution. NO_x consists mainly of NO and NO_2.

For human health, primarily NO_2 is relevant. Reduction of the particle emission of diesel engines, however, led to increased emission of NO_2, and today NO_2 amounts to 20 – 40 % of all NO_x.

So this is an important reason why in the planning of tunnel projects – particularly for tunnels in cities – filtration not only of particles but also of NO_2 should be considered!

For very long road tunnels, a bypass solution, e.g. cleaning of the air and return into the tunnel, will be an economic solution compared to air exchange.

Here, too, it may be sensible to reduce NO_2 in order to keep pollutant concentrations for the drivers as low as possible.

MODE OF OPERATION

Ideally downstream of our ECCO filter system, the ECCO*NOxCAT* removes nitrogen dioxide (NO_2) and other pollutants. The structure can hardly be any simpler.
Activated carbon with very special catalytic properties (*NOxCAT*) is filled into a specially designed filter frame. Removal occurs both by adsorption and by a catalytic reaction so that NO_2 is both chemically bound in the form of surface oxides and converted into harmless reaction products. The ECCO*NOxCAT* works reliably and without any further effort. Moreover, in addition to dangerous nitrogen oxides, other pollutants such as ozone, SO_2 or hydrocarbons are also removed.

ADVANTAGES

Thanks to the catalytic properties, we guarantee long service life without special maintenance:

- No handling of hazardous chemicals
- No regeneration required
- Long service life
- Removal of ozone, SO_2 and hydrocarbons

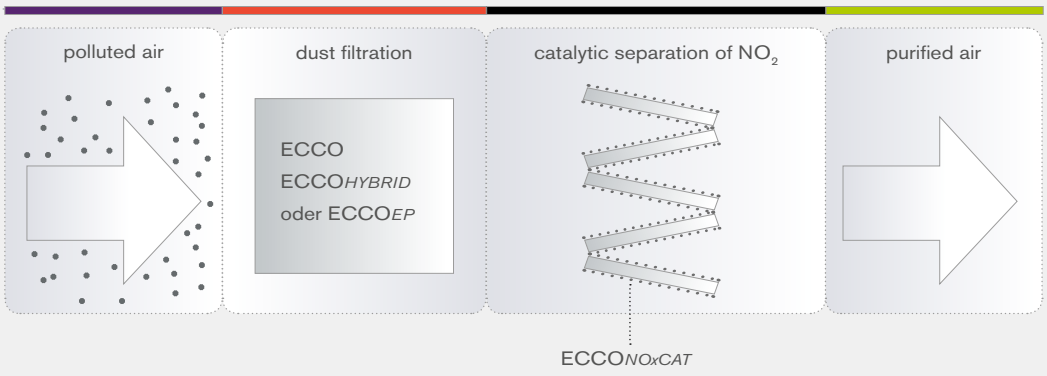
DURING OPERATIONS

The design of the ECCO*NOxCAT* is very easy, what means efficient and cost-saving installation. No maintenance is required. Very high life time of the ECCO*NOxCAT*, tested in real operation, where after 26,000 hours the removal of NO_2 was still as high as at the beginning.

TECHNICAL DATA

Efficiency NO_2	> 80	%
Hydrocarbons	50-95 depending on HC	%
Pressure loss	250-500	Pa
Life time	> 26.000	h
By-Pass	Yes, because of risk of self ignition	

ECCO*NOxCAT*



The ECCO*NOxCAT* is designed streamlined to keep pressure loss as low as possible. The polluted air flows through the ECCO*NOxCAT* at very low speed only, ensuring maximum removal efficiency and low energy consumption.

CLEAN IN BUILDING

Special filters to reduce exposure of workers and environmental burden when building tunnels

Good Luck

aigner®

TUNNEL TECHNOLOGY

BREATHE FREELY IN BUILDING: ECCO*DUST*

Building work on a tunnel construction (e.g. road, railway or subway tunnel) releases large amounts of dust, typically caused by removal and securing works.

REDUCE ENVIRONMENTAL FOOTPRINT

Particularly in the vicinity of the portals or exhaust openings, the neighbours around are heavily exposed during the building phase. Our ECCO*DUST* is designed specifically to meet this requirement and was first used for portal dedusting during the construction of the Wienerwaldtunnel Ost (Austria).

ENORMOUS EXPOSITION OF THE TUNNEL WORKERS

The workers in tunnelling are exposed to enormous burdens. In order to guarantee compliance with the workplace limit values for dust and other pollutants, mobile exhaust and filter systems are used on-site.

MODE OF OPERATION

Fresh air ① is generally introduced directly into the working area ③ via extensible ventilation ducts ②. Dust produced e.g. by blasting or milling or stirred up by trucks driving in the tunnel ④ is filtered and clean air is blown out into the open through the tunnel portal or an exhaust opening after filtration ⑦.

The design of our ECCO*DUST* filter system is based on the tried and tested ECCO filter technology for exhaust air cleaning of road tunnels. As the particles released by tunnelling are much larger than e.g. diesel soot, removal is done purely mechanically, using a special filter media.

The ECCO*DUST* is cleaned by aspiration of the filter media. The cleaning process can be triggered fully automatically by measuring differential pressure or by means of an intelligent timer. The dust produced is removed in a particle filter and can be disposed of simply and quickly using dust bins or Big Bags.

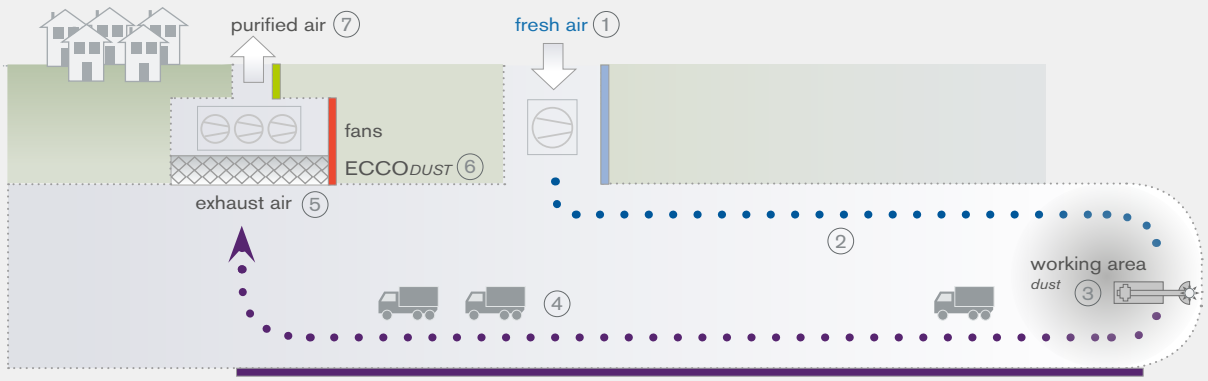
FIELDS OF APPLICATION

For portal dedusting or dedusting at exhaust openings with large air volumes

ADVANTAGES

- High removal efficiencies of circa 81 % (measured during drill-and-blast work in the construction of the Wienerwaldtunnel in Austria)
- Small dimensions
- Lower costs than with conventional filter systems
- Removes dust from other sources, too
- Fully automatic filter cleaning system

ECCO*DUST*



Fresh air is blown into the working area ③ through ducts ②. The contaminated waste air is filtered in the ECCO*DUST* ⑥ and blown out after cleaning ⑦. Thus, neighbours are optimally protected from impermissible dust exposure.

MODE OF OPERATION

For capture of the dust directly at the place of formation, compact and space-saving filters are required which are also suitable for robust use in the tunnel. These filter systems are mounted on a stable sledge, but can also be installed on a truck or railway carriage. The dust is removed in special filter elements which are automatically cleaned using pressurized air.

We mostly provide complete filter units including axial or radial fans, sound absorbers and switchboards which can be commissioned simply and quickly on-site.

BUY OR LEASE

We make it easy for our customers to decide in favour of our mobile dry dedusters: Buy the entire filter system – or simply lease it for a certain time!

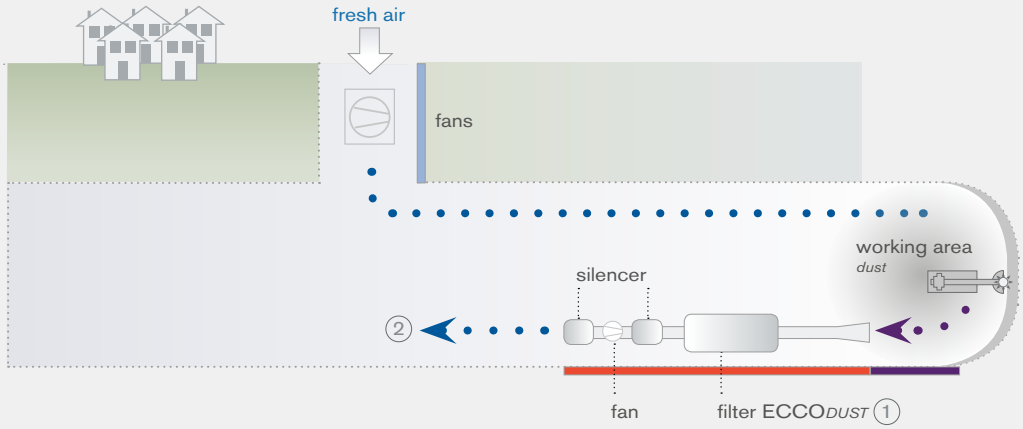
FIELDS OF APPLICATION

Mobile dedusting for extraction directly at the point of formation in the working area

ADVANTAGES

- Massive construction for heavy duty work
- Compact filter elements with removal efficiency of up to 99.997 %
- Residual dust guarantee < 0.1 mg/m³ for asbestos applications
- Fully automatic filter cleaning system with pressurized air
- Various dust discharge systems
- All filters are certified according to ATEX

MOBILE *FILTRATION UNITS* • dry dedusting



Dust is captured as close to the point of formation and thus most effectively ①. The air cleaned with removal efficiencies of up to 99.997 % is fed back into the tunnel ②.

MODE OF OPERATION

Wet dedusters are ideally suited for wet operating conditions in tunnelling. They work without filter media where moist dust might cake. Special nozzles ① are used to create a thin mist of water binding the dust particles. This mixture of dust, water and air flows through the demister ② where further mixing is performed.

In the following droplet separator ③, the dust particles are definitely removed. The water used here is fed back into the cleaning process ④, guaranteeing economic operations.

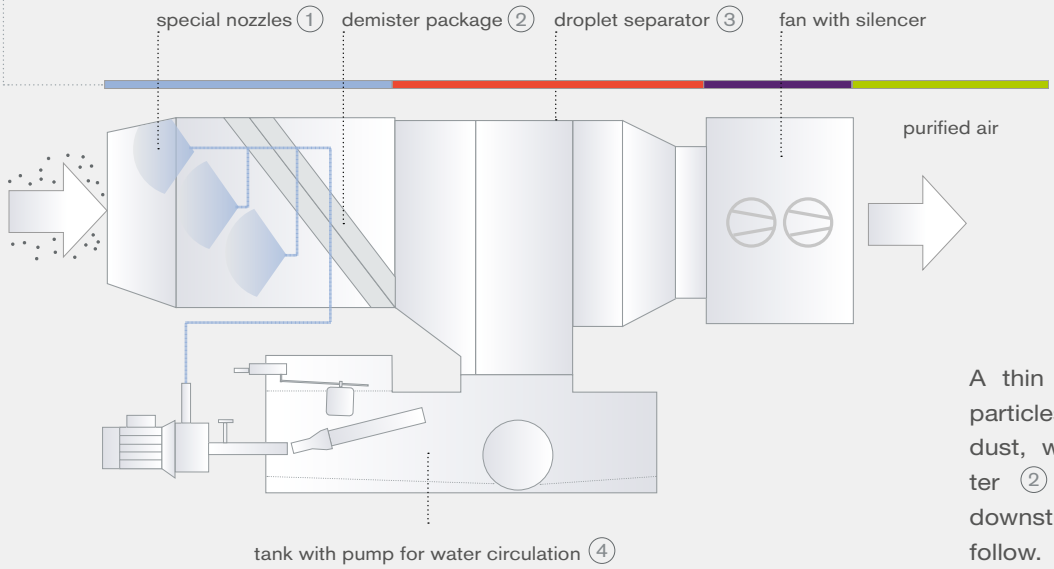
FIELDS OF APPLICATION

For moist to wet operating conditions and for removal of nitrous gases produced by blasting

ADVANTAGES

- Removal efficiency of up to 99.6 % (testing dust)
- Airflow rates from 120 bis 1,500 m³/min
- Removal of nitrous gases during drill-and-blast tunnelling
- Particularly space-saving and flexibly usable

MOBILE *FILTRATION UNITS* • wet dedusting



A thin water mist binds the dust particles, and intimate mixing of dust, water and air in the demister ② and final removal in the downstream droplet separator ③ follow.

FREE VIEW

Free view and good orientation for persons in case of fire in a tunnel

aigner®

TUNNEL TECHNOLOGY

SAFE! EVEN IN CASE OF FIRE

Fire in a tunnel is always an incident associated with a very high risk for the users of the tunnel. However, not the fire is the greatest danger – the smoke produced by the fire is.

Even with up-to-date emergency ventilation, the spreading of the smoke cannot always be controlled sufficiently, especially if meteorological conditions such as strong wind counteract this. Hence, smoke must be removed efficiently, at the proper point and as quickly as possible.

LIFE-SAVING

To save lives, for such requirements we have developed our FIRE*CURTAINS*. This makes it possible that in case of fire persons have free view and can easily find their way! This saves the persons in the tunnel from getting lost and suffocating in the tunnel.

MODE OF OPERATION

At tunnel portals there may exist e.g. meteorological wind pressure (or in mountainous areas e.g. barometric pressure difference) which can change very quickly. This poses a task almost insurmountable for ultramodern systems for fire smoke ventilation.

With FIRE*CURTAINS*, natural airflow in the tunnel is strongly reduced. This enables the existing smoke ventilation to effectively keep smoke-free and safe the areas where persons are.

SOPHISTICATED SYSTEM

To protect the FIRE*CURTAINS* and their mechanics from soiling, they are installed in a closed casing of stainless steel at the ceiling of the tunnel ①. In case of fire, a slider first opens this casing and closes it again fully automatically after the curtains have been lifted again.

To achieve a stable position of the curtains, they are provided with special weights ② . The lamella form ③ enables vehicles (cars and trucks) as well as pedestrians to pass through simply and safely.

INSTALLATION AND DESIGN

Ideally, installation of FIRE*CURTAINS* is already considered during the planning for new road tunnels. Of course, FIRE*CURTAINS* can be installed during refitting of existing tunnels as well.

To make sure our FIRE*CURTAINS* offer optimal safety for tunnel users, we perform a detailed technical calculation and design for each project.

FIRE*CURTAINS* • front view

① casing ② weights ③ lamella

PASS THROUGH SIMPLY AND SAFELY

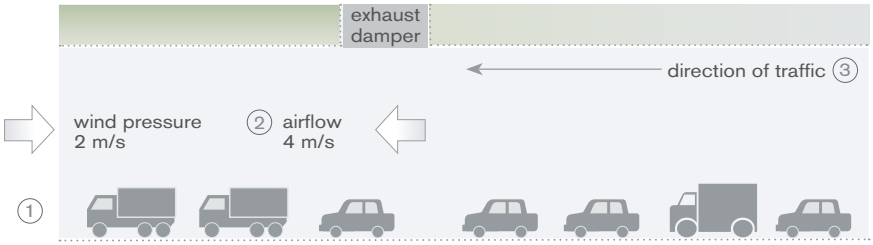
Clearly visible signs on the curtains show a directional arrow (EXIT) and thus invite to drive through slowly. Vehicles as well as pedestrians can pass through the FIRE*CURTAINS* very easily and safely.

The following examples were visualized using a computer simulation (CFD). In fact, however, the function was also demonstrated in a practical test in the currently probably safest tunnel in Roppen (Austria).

FIRE*CURTAINS* EXAMPLE 1 • HIGH TRAFFIC LOAD

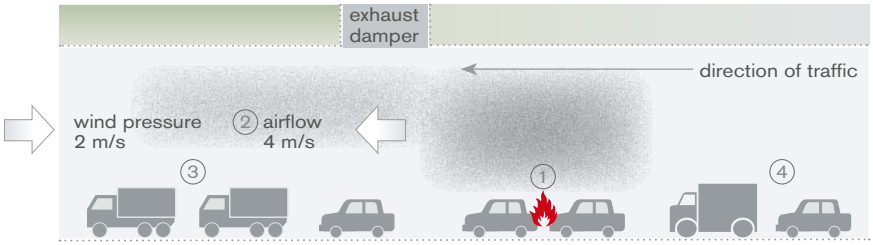
1. INITIAL SITUATION

Even if there is wind pressure on the exit portal ①, the piston effect of the vehicles produces an actual airflow ② in the direction of traffic ③.



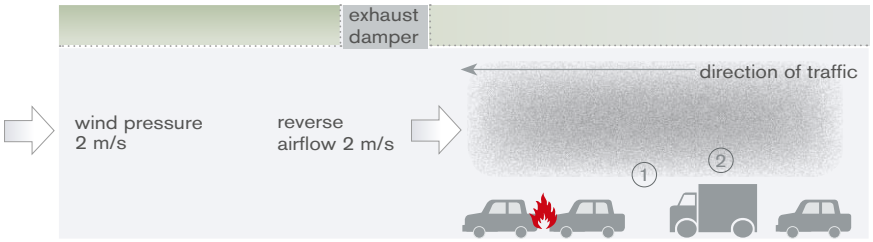
2. ACCIDENT

When fire breaks out due to an accident ①, the smoke produced first flows towards the exit portal ②. Vehicles beyond the site of the accident leave the tunnel ③, those before it come to a halt ④.

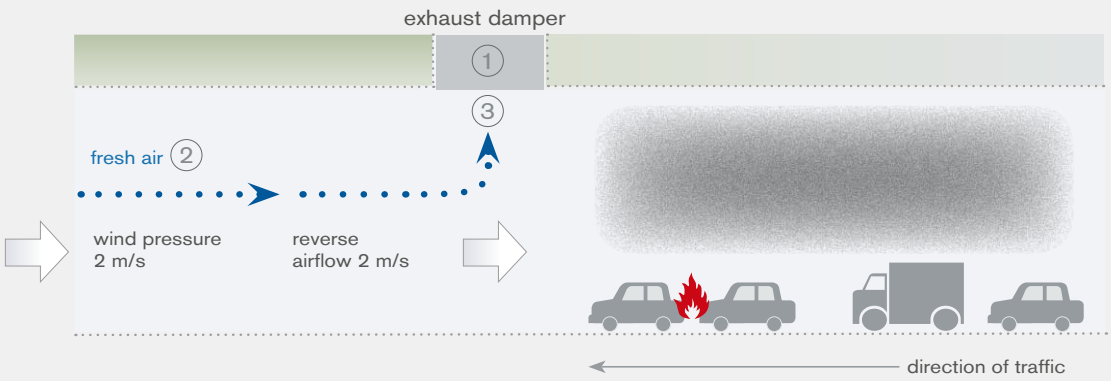


3. INVERSION OF AIRFLOW

When all vehicles have either left the tunnel or are stalled before the place of the fire ①, the piston effect of the moving vehicles ceases. This results in an inversion of the airflow in the tunnel, so that the rising smoke begins to stream towards the stalled vehicles ②.



SITUATION WITHOUT FIRE*CURTAINS*



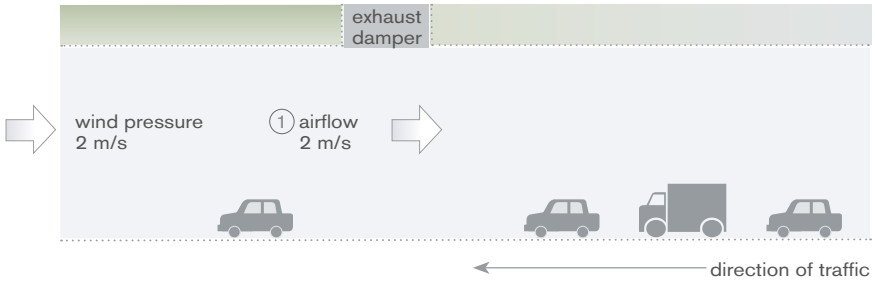
After the extraction fans ① have been turned up to maximum after the onset of the fire, due to the direction of the flow mostly fresh air is drawn in from the exit portal ② and extracted at the extraction port ③. Due to the thermal situation, the air before the place of the fire will flow towards the entry portal, so that the cars stalled there and the persons will be in the smoke.

Deadly danger!

FIRE*CURTAINS* EXAMPLE 2 • LOW TRAFFIC LOAD

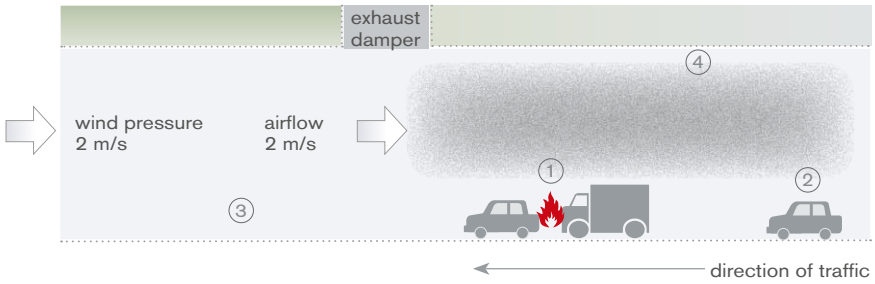
1. INITIAL SITUATION

Under conditions of low traffic load, from the start there is an airflow against the direction of the traffic in the tunnel ①. Due to the low or absent piston effects of the vehicles, airflow towards the entry portal dominates.

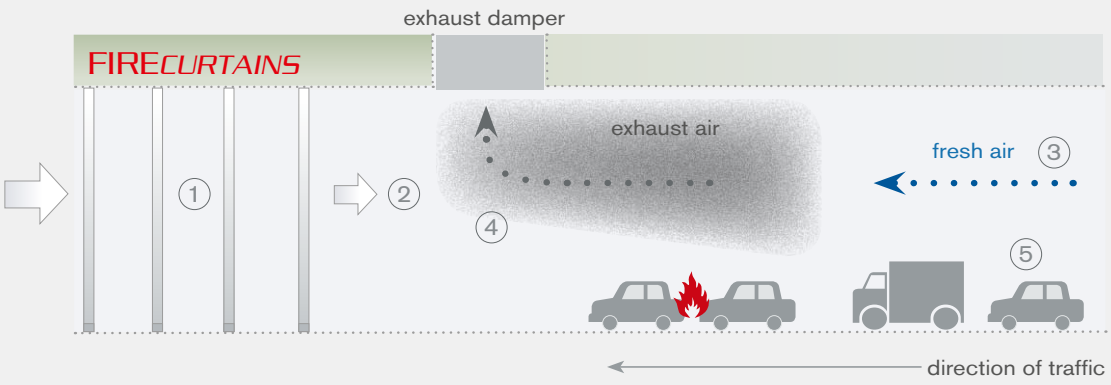


2. U2. ACCIDENT

When fire breaks out due to an accident ①, the vehicles before the site of the accident come to a halt ②, those beyond it leave the tunnel ③. The original direction of the airflow is maintained, blowing the rising smoke towards the stalled vehicles ④.



SITUATION WITH FIRE*CURTAINS*



The activated FIRE*CURTAINS* ① increase flow resistance at the exit portal, thereby strongly reducing wind pressure ②. Thus, the fire aspiration system can now mostly remove air from the entry portal ③, and thus the rising smoke is specifically removed ④. The stalled vehicles remain now (in contrast to the situation without FIRE*CURTAINS*) free of smoke and safe ⑤ !

Life-saving for the persons!

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