Cleanable filter

Cleanable filters are used to separate solid particles from gases when cleaning exhaust air having high concentrations of dust. The cleaning effect is based on the so-called "surface filtration". In surface filtration, the particles are mostly separated when contacting the particle layer (dust cake) forming on the surface of the filter media. After a specified pressure drop is reached, or at fixed intervals, the filter media are cleaned off so that the filtration process can be repeated periodically. The separated dust can be recovered.

The types of cleanable filters differ in terms of the geometric arrangement of the filter media, the gas flow and the cleaning method.

Filtering separators also differ in the type and manufacture of the filter material. Filter media types include bag filters, pocket filters, cartridge filters, pleated filters, and cassette filters.

Cleanable filter

Cleaning		shaking, back-flushing or compressed air
Typical parameters:	Residual dust concentration	1 - 20 mg/m³ (filter cassette < 0,001 mg/m³)
	Particle size distribution	< 0.1 - 100 µm
	Temperature	-40 - +260 °C
Filter media		Needle felts, spunbonds, wet-laid papery nonwovens

	Cleanable filter	
Typical characteristics	Weight per unit area	150 - 700 g/m³
	Air-to-cloth ratio	30 - 180 m³/m²/h
	Differential pressure at commissioning	200 - 500 Pa*
	Differential pressure in operation	500 - 1,500 Pa*
Geometry		bag filter, pocket filter, cartridge filter, pleated element filter, cassette filter, rigid filter

*sintered filter elements are brandspecific, partly significantly higher

Geometry of bag filters, pocket filters, cartridge filters, pleated filters and cassette filter

Geometry of bag filters, pocket filters, cartridge filters, pleated element filters and cassette filters

- In **bag filters**, the filter element is usually a cylindrical tube. The filter bags are produced in various diameters and lengths. They cover the complete spectrum of < 0.5 m² to > 100,000 m². Bag filters are used to filter exhaust air at low and medium temperatures of up to approx. 260°C, with the filter bag holding back the dust as the air flows through. Filter bags must be regularly cleaned, usually with compressed-air blasts. The cleaning effect of each blast of compressed air is intensified by the sudden expansion of the filter bag. Bag filters are therefore best suited for sticky/strongly adhesive dust.
- **Pocket filters** are used to remove dust from smaller quantities of gas. The operating temperatures correspond to bag filters. The filter medium is stretched over flat, plate-like frames open on one side for the clean gas to escape. The gas flows from the outside inward. Pocket filters are cleaned regularly, usually with compressed-air blasts. The cleaning effect of each blast of compressed air is intensified by the sudden expansion of the filter pocket. This effect is only marginally weaker in pocket filters than in bag filters. Pocket filters are therefore also best suited for sticky/strongly adhesive dust.
- **Cartridge filters**are an alternative to bag filters that is being used more and more. The filter medium is folded into a star shape and placed over a cylindrical supporting cage. The gas flows from the outside inward, and the filter is cleaned by pressure shocks or low-pressure washing. Cartridge filters are used only for dust that is easy to clean off, since otherwise the folds become clogged with dust. The operating temperature is limited to approximately 200 °C.
- **Pleated element filters**are an alternative to pocket filters. Two folded filter media are placed on top of one another, then glued or welded together where they come into contact. The gas flows from the outside inward, and the filter is cleaned by pressure shocks or low-pressure washing. Pleated filters are used only for dust that is easy to

clean off, since otherwise the folds become clogged with dust. The operating temperatures are typically around 130 °C.

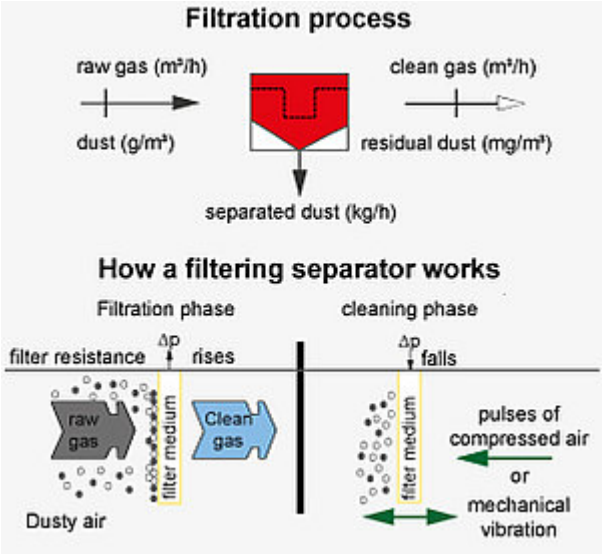
- In **cassette filters** ("HEPA filters"), the dust-laden gas usually enters the raw-gas chamber of the filter housing in the lower part, where it is pre-separated, and then flows through the first filtering stage. Entrained fine dust is separated on the outside of the folds of the filter cassette. Filter cassettes are cleaned pneumatically. A nozzle pipe slowly moves back and forth over the entire width and length of the filter cassette. The compressed air blows out the filter cassette downward, removing dust from the filter elements. The clean gas from the first filtering stage can then pass through a second, uncleaned filtering stage if desired (safety filter, police filter). The operating temperature range is limited to a maximum of 180 °C.
- **Rigid filters** mostly consist of a very porous sintered plastic framework on which often a PTFE membrane is laminated. The dust separation is only on the membrane then. The self-supporting rigid body below the membrane has no filtering function anymore. On the one hand the anti-adhesive PTFE membrane can be used for sticky dusts, on the other hand, the rigid body elements lack blowing up in spite of jet-pulse and with it a kinetic support of the blowoff process.

How filtering separators work

How filtering separators work

Ordinarily, the particle-laden gas flows through the filter elements from the outside inward: The air flow deposits the filtrate onto the outside of the filter media. This forms a layer of dust, known as the filter cake.

The filter media must be cleaned periodically. Brief blasts of compressed air, mechanical vibration or back-flushing with air are used to remove the dust cake. The dust layer falls down, e.g., into a collection hopper that is regularly emptied (e.g., by a rotary feeder).



Operating performance of filtering separator

Operating performance of filtering separators

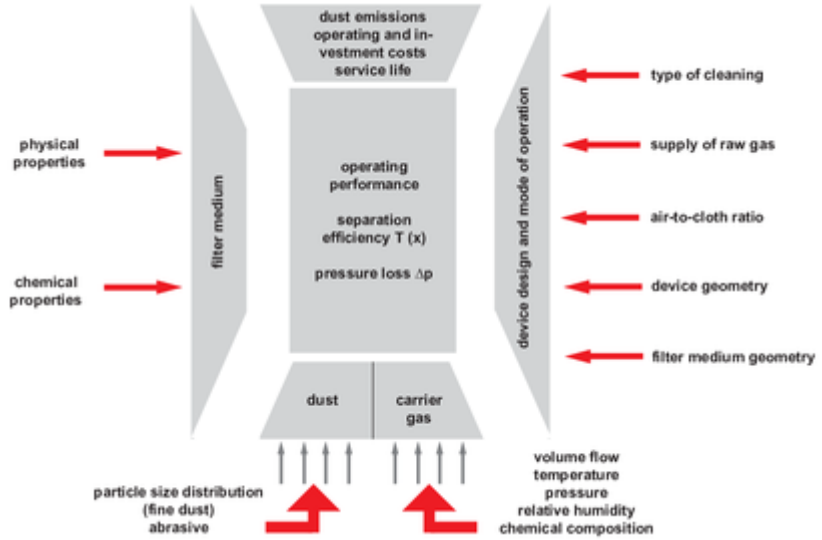
The operating performance depends on a number of factors, which need to be considered when designing a dust extractor. The have a decisive influence on te functionality of the entire system.

Primary determining factors:

Chemial and physical properties of the carrier gas	corrosive, dry / dew point
Chemial and physical properties of particles	particle size distribution, density, particle form, abrasiveness, agglomerating, fibrous, hygroscopic, sticky, corrosive, liquid aerosols existing
Physical properties of the separated dust	bulk density, bridging, free-flowing, dumping angel
Process parameter	volume flow, raw gas dust concentration, operating pressure, temperature
Operating method of the plant	continuous, discontinuous
Necessities depending on the installation site	maximum dimensions - length, width, height (incl. free space for filter media change)
Technical explosion and flame parameters of carrier gas and particles	

Secondary determining factors:

Safety requirements	Explosion protection concept, required clean gas value, dust exposition of employees during service works (dust release during change of filter media and container), disposal of the dust
Production features	cleanability (CIP), FDA suitability, suitable for food, decontamination
Economic features	24h operating, online filter change, service friendliness, cost analyses over the plant lifecycle



The primary and secondary features are the parameters for designing a filtering installation and set up the basis for the following constructional characteristics of procedural filter plants:

Kind and form of filter elements:

- filter confection and geometry: bag, pocket, cartridge, rigid-body, pleated elements, cassette, etc.
- filter material: polyester, polypropylene, PTFE and much more

Design of the filter plant:

- air-to-cloth ratio
- geometry: rectangular, round
- raw gas channel: horizontal, vertical (axial), tangential, pre-separator, downflow principle, terminal velocity
- cleaning principle: jet-puls, back-flush, shaking
- design of the dust discharge: discharge, hopper inclination
- kind of filter media change, raw gas side, clean gas side, horizontal, vertical, dust-free, safe-change, wetting

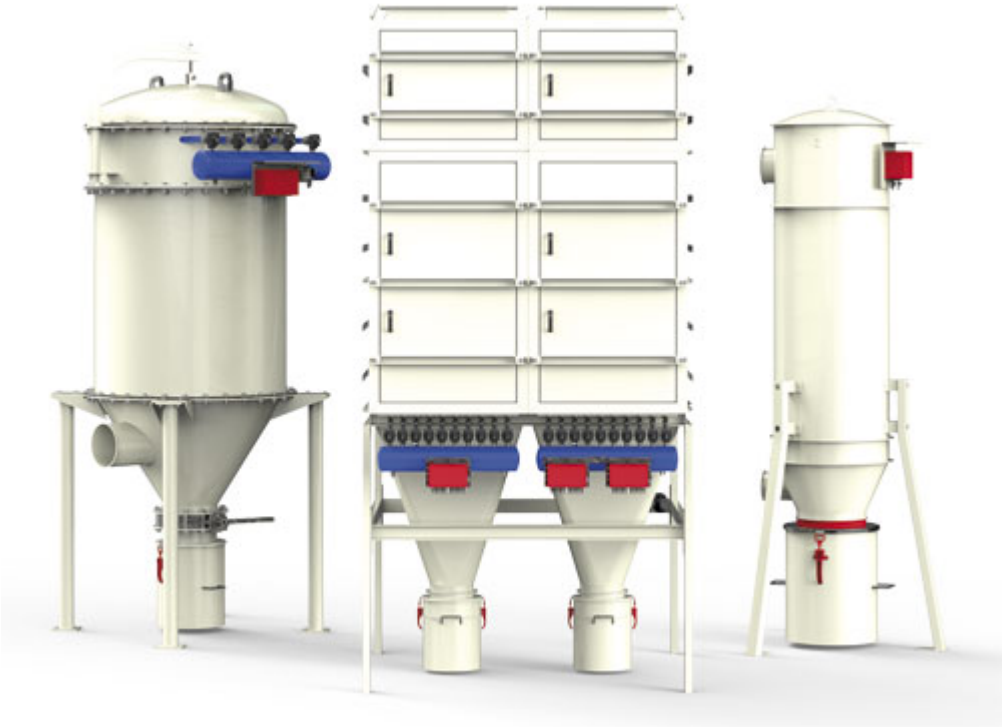
Besides the primary - mostly procedural - influencing factors, the safety-related parameters and production-related features become increasingly important.

Constructive design

Constructive design

Filtering separators (stand alone unit) in principle consist of:

- Filter head with regeneration device (today typically compressed air cleaning)
- Intermediate base for holding the filter elements
- Filter elements
- Housing
- Dust collecting bin
- Dust discharge in various designs
- Additional components, e.g., cleaning controller and discharge elements



Typical design parameters for filters with mechanical cleaning, back-flushing and jet pulse cleaning

Typical design parameters for filters with mechanical cleaning, back-flushing and jet pulse cleaning

	Fabric filter with mechanical cleaning	Cassette filter with back flushing (1)	Filter with jet-pulse cleaning
Gas volume flow	500 m^3/h	300 - 30,000 m^3/h	2 - >2,000,000 m^3/h
Filter area	> 5 m^2	10 - 300 m^2	0,1 - >20,000 m^2
Air-to-cloth ratio	0.7 - 1.5 m^3/m^2 min	0.5 - 1.7 m^3/m^2 min	0.5 - 3 m^3/m^2 min
Dust load	0.5 to 500 g/m^3	< 1 g/m^3	0.5 to 500 g/m^3
Cleaning	• shaking • small energy input into filter media • only offline	• reverse gas flow • medium energy input into filter media • online by parallel connection	• pressure shock • high energy input into filter media • online or offline
Filter material	fabric	micro-fibreglass or nonwoven with PTFE membrane	needle-felt, nonwoven, sintered plastic

(1) Infastaub uses back flushing only for cleanable cassette filter type MKR, on which the above mentioned figures rely to. Reverse air cleaning filter with filter pockets or so-called lay-flat-bag elements of diverse producers can cope with volume flows up to 100,000 m^3/h

with accordingly high filter surfaces.

Economic considerations of filter systems

Economic considerations of filter systems

After technical clarification, very different plant designs are available. These can be commercially compared. But today, a simple cost consideration existing of investment costs and expecting filter life time is not timely anymore.

This shouuld be changed by an economic consideration over the entire plant life time. The following features should be considered:

- investment costs
- energy costs
- fan
- energy costs of filter cleaning (pressurized air, respectively nitrogen or similar / power)
- costs filter media as well as general costs for spare parts over the entire plant life time (including costs for assembly)
- production downtime costs during filter media change
- estimated costs for dismantling and possibly decontamination

Selection aid for construction types of filter systems

Selection aid for construction types of filter systems

Every on the market existing cleanable filter design has because of their special features its reason for existence.

The following table shall only highlight the special weaks and strengthens of the construction designs, in order to find the appropriate solution for a filter project. Only single stage plant up to a volume flow of about 100,000 m^3/h are considered. The presented ratings are relatively to the particular comparing design, beginning with the most appropriate (+++). Features, that have only slight deviations, are not displayed in the overview.

	Bag	**Pocket**	**Cartridge**	**Pleated element**	**Sintered plastics**	**Cassette**	**E-filter**	**Washers**
Location								
low construction height	-	+	++	++	+	+++	-	-
small footprint	+	+	++	++	+	+++	-	-
Dust character								
dust amount >20 g/m^3	+++	+++	++	++	++	-	++	+

smallest dust amount *	+	+	++	++	++	+++	+	+
very humid, sticky or very hygroscopic dust	+++	++	-	+	+	-	+	+++
abrasive dust	++	++	++	++	+++	+	++	++
finest dust (< 1 µm)	++	++	++	++	++	+++	+	+
extreme light dust	+	+	+	+	+	+++	+	+
Process parameter								
temperature max. **	260 °C	260 °C	200 °C	130 °C	230 °C	180 °C	500 °C	60 °C
Filter change								
in operation	+	+	+++ (nur MPR)	+	+	+++	n. a.	n. a.
fast	+	+	+++ (nur MPR)	++	++	+++	n. a.	n. a.
low-dust	-	++ (AJNS)	+++ (nur MPR)	++ (AJLS)	++ (AJLS)	+++	n. a.	n. a.
safe-change-***	-	-	+++ (nur MPR)	-	-	+++	n. a.	n. a.
OEB-requirements ****	-	-	+++ (nur MPR)	-	-	+++	n. a.	n. a.
Other								
oOffline	+	+	+++ (nur MPR)	+	+	+++	+	-
online	+++	+++	+++ (nicht MPR)	+++	+++	-	+++	+++
pressure loss	++	++	++	++	+	++	+++	++
product recovery	+++	+++	+++	+++	+++	++	+++	-
residual dust content	++	++	++	++	++	+++	+	-
easy interior cleaning (product side)	+	+	+	+	+	+++	-	-
WIP	++	++	+	+++	+++	+	n. a.	n. a.
CIP	+	+	-	++	++	-	n. a.	n. a.

* no development of a filter cake expectable
** without metal or ceramic filter elements
*** change collar with double groove
**** without moistening

Market place

You find the market place for used filter units here.

Downloads

You find all manuals PDF files here.

Trade fairs

You find all upcoming fair dates here.

Newsletter

Sign up here for our newsletterand make sure to receive free tickets for our trade fairs.

Filter Units

- Pocket filter
- Cartridge filter
- Bag filter
- Pleated element filter
- HEPA filter
- Shaking filter
- Top filter
- Special applications

Solutions

- Industries
- Dedusting tablet production
- Dedusting sack emptying
- Dedusting waste recycling
- Dedusting production of baby food
- Dedusting ship unloading
- Silo dedusting
- Dedusting steel production

After-Sales

- Service features
- Spare parts service
- News

Dust Removal Knowledge

- Encyclopaedia about dedusting
- Planning
- Cleanable filter
- Depth filter
- Explosion protection
- Filter media
- Legal regulations
- Glossary

Company

- Contact
- Legal notice
- General terms and conditions

News

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