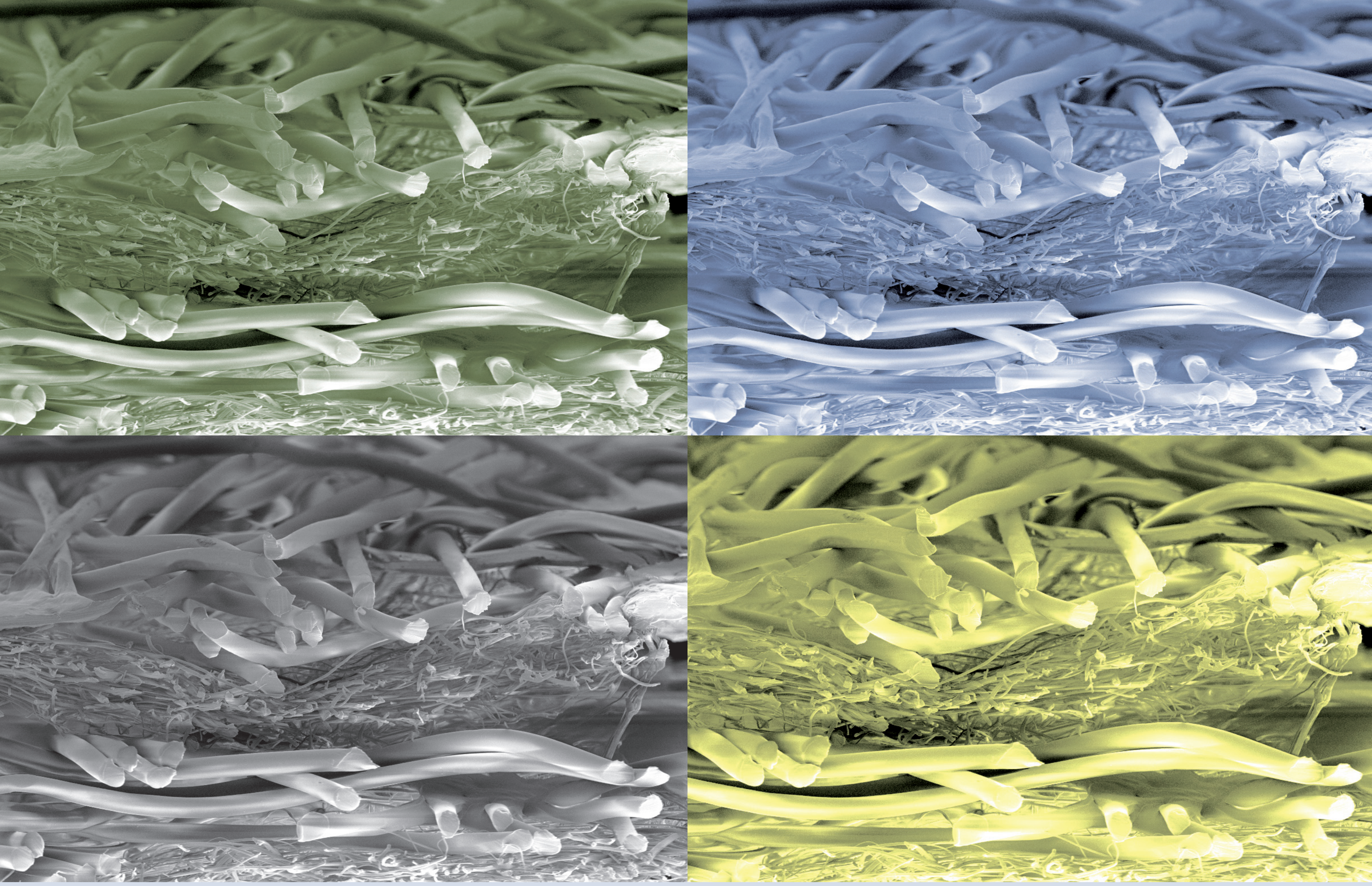


POCKET-FILTER

Essentials

Kalthoff®

Your Partner for filter technology

APPLICATION INDOOR AIR HYGIENE

Bag-type filters are widespread products for the filtration of outdoor air in ventilation and air-conditioning systems. They are required in order to remove atmospheric components of the ambient air. As a result, they achieve a hygienically clean operating state of the ventilating and air-conditioning systems and the rooms supplied with air.

Ambient air includes a widely-distributed spectrum of particles (liquid or solid), as well as gaseous components with different chemical, physical and biological properties. A differentiation is made here between particles of natural origin and particles of civilizing (anthropological) origin. It depends on the extent to which toxicity can exist for humans.

A further feature is the fineness of the particles which extends from the nano-range (approx. 0.01 µm) to the millimeter range (1000 µm). It has been identified that through the fineness alone, particularity in case of the ultra-fine particles, a harmful effect on human health exists. In ventilating and air-conditioning systems the effect is especially critical, since large fresh air volumes are moved for the supply of persons, and harmful additions are transported directly to the person. In addition, deposited particles in system aggregates, in combination with high air humidity levels lead to hygienic impairment through biological growth, propagation and dying, called plant fouling.

Since 1989 the VDI 6022 “Hygiene requirements for ventilation and air-conditioning systems and –units” has existed, which regulates the employment, requirements, properties and change cycles or air filters in ventilating and air-conditioning systems.

Since 2017, the DIN EN 16798 has also been in existence. It replaced the EN 13779 and establishes the validity of these rules for the EU area. As well as this, air qualities of outdoor air (ODA) and supply air (SUP) are defined as a function of which certain filter qualities are stipulated (see table 1).

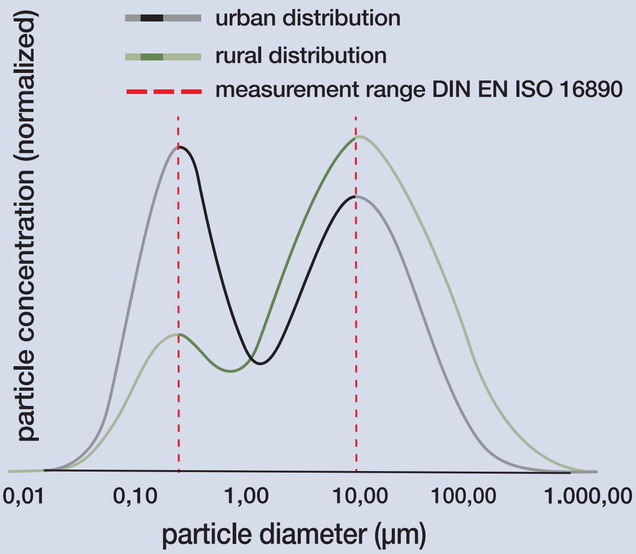
Table 1: Minimum filtration efficiencies

Outdoor air	Supply air				
	SUP 1 (very high)	SUP 2 (high)	SUP 3 (medium)	SUP 4 (moderate)	SUP 5 (low)
	ePM_1*	ePM_1*	$ePM_{2,5}$**	ePM_{10}	ePM_{10}
ODA 1 (clean)	70%	50%	50%	50%	50%
ODA 2 (contaminated)	80%	70%	70%	80%	50%
ODA 3 (highly contaminated)	90%	80%	80%	90%	80%

**final filter stage should be minimum ePM_1 50%*
***final filter stage should be minimum $ePM_{2,5}$ 50%*

THE FILTER TEST STANDARD DIN EN ISO 16890

For planners and operators of ventilation systems, a practical and industry-wide evaluation of filter is essential when choosing the right air filter. Since July 2018, DIN EN ISO 16890 has replaced EN 779 as testing standard for this purpose. Unlike in its predecessor, the filters efficiency is measured against a particle collective and refers to typical particle distributions in outdoor air in order to classify air filters. This results in measurement outcomes that can be applied to real situations. The distributions as well as the particle size range relevant for filter classification are shown in Figure 1. During the test, the fractional efficiency for particle diameters from 0.3 to 10 µm of a new air filter is first measured. The filter element is then exposed for 24 hours to an isopropanol (IPA) vapor atmosphere. This procedure should neutralize any possible electrostatic charges on filter fibers. Subsequently, the fractional efficiency is measured again. The result is a minimum efficiency, which can be expected under extremely critical, real operating conditions.



Urban and rural particle distributions acc. to DIN EN ISO 16890

From the fractional efficiency of the new filter as well as the IPA-treated filter, a weighted average is calculated. The weighting is based on the urban particle size distribution for ePM1 and ePM2.5 filters and on the rural particle size distribution for ePM10 filters. From this average, the filter efficiency is derived for the filter group ePM1 in the size range 0.3 µm – 1 µm, as well as for the filter groups ePM2.5 (0.3 µm – 2.5 µm) and ePM10 (0.3 µm – 10 µm). In the same way a minimum efficiency is determined for each of the three groups from the minimum fractional efficiency curve.

Based on the filter groups, the filter classes are defined (see Table 2). They have to be designated by a preceding 'ISO' and additionally indicate the efficiency rounded down in 5% increments. One example could be the filter class ISO ePM1 70%. For the classes ISO ePM1 and ISO ePM2.5, the respective minimum efficiency has to be above 50%. For the class ISO ePM10, the average efficiency has to be above 50%.

Table 2: Overview of the filter classes according to DIN EN ISO 16890

Class acc. to DIN EN ISO 16890	Minimum requirements acc. to DIN EN ISO 16890	Corresponding EN 779*
ISO ePM1	Minimum efficiency ePM1 ≥ 50%	F7, F8, F9
ISO ePM2,5	Minimum efficiency ePM2,5 ≥ 50%	M6, F7
ISO ePM10	Average efficiency ePM10 ≥ 50%	M5, M6
ISO Coarse	Average efficiency ePM10 < 50%	G4, M5

**Serves as a guideline; a clear translation is not possible due to the different testing methods.*

To assess the dust holding capacity and the efficiency against coarse dust, the filter element is loaded with quartz sand, the so-called A2 fine dust. In several steps, the filter is loaded with defined amounts of dust at the nominal volume flow, and the pressure drop is determined. The filter efficiency against the first 60 g of dust is specified in the filter class ISO Coarse. The increase of the pressure drop during dust loading is an indicator for the possible service life of a filter and can be used to calculate further parameters, such as the annual energy consumption according to Eurovent.

FILTER MEDIA MADE OF MICROGLASS FIBRES

If the required properties of deep-bed filter media are considered, nonwoven of microglass fibres technically represented the almost ideal material in the past and have therefore been employed since the 1970's.

However, scientists determined in the 1990's that under certain conditions microglass fibres have a carcinogenic effect on living organisms. This is due to the properties of microfine brittle fibres which break easily and can be verified as shedding from the air filter into the supply air. Via the respiratory organs they reach the living organism and similar to spear tips they can remain in the body cells for a long time.

Health hazard

A danger of tumours arising has been verified in animal testing, so that microglass fibres are mostly classified according to the Deutsche Gefahrstoffverordnung (direction on hazardous materials) TRGS 905 "Carcinogenic materials" into category 1B. Category 1B includes substances that are probably carcinogenic to humans. These include among others, carcinogenic occupational substances with an extended half-life, i.e. substances in the human organism dissolving within a predefined period to 50% of their original number. The actual TRGS 905 (2016) does not give a definite statement concerning the classification of microglass fibres with a short half-life less than 40 days. However, it is assumed that the carcinogenic potential versus fibres with extended in-vivo stability is lower.

HEPA glass fibre media

It is the company philosophy of Kalthoff to generally avoid the employment of microglass fibres, since we see the basic concept of room air hygiene being compromised by the utilization of potentially hazardous substances.

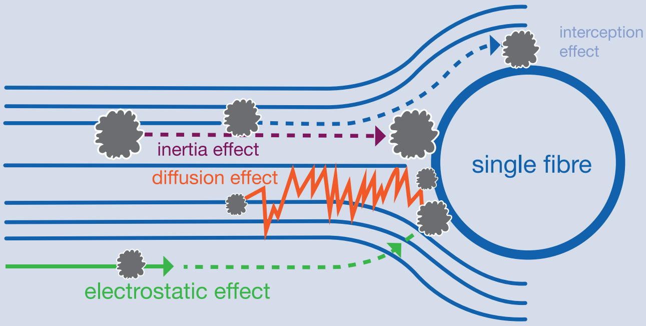
Kalthoff composite media are therefore fully-synthetic and free of microglass fibres and also free of additions. In this way we make our contribution to responsibility in the product and product safety areas, according to state-of-the-art knowledge and technology.

Fibre structure of microglass media

THE PRINCIPLE OF DEPTH FILTRATION

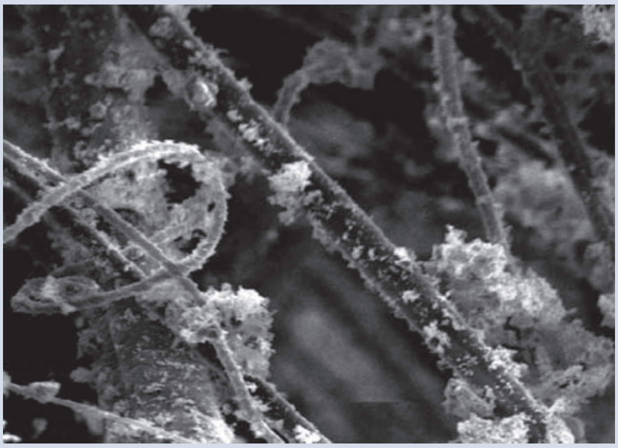
Pocket filters basically work according to the deep-bed filter principle. Particles are deposited in the depth of the filter media on air-circulated fibres according to impact probability. For this reason, deep-bed filter media must always be very porous to enable the admission of fine and coarse particles into the depth of the media. Furthermore, a more voluminous open-pore structure facilitates the deposition of maximum quantities of deposited particles without the resistance increasing considerably due to the air flow of the deep-bed filter. In this sense a porous, voluminous, fibre structure is important at all times in order to generate a low aerodynamic resistance (pressure-drop).

A further important feature of deep-bed filter media is the fibre diameter. With decreasing fibre diameter the probability of the separation of particles is increased considerably. If the finest particles < 1 µm should be separated out to a large degree, for purely physical reasons fibre diameters must be smaller than 3 µm, where the finer they are the more effective they are.



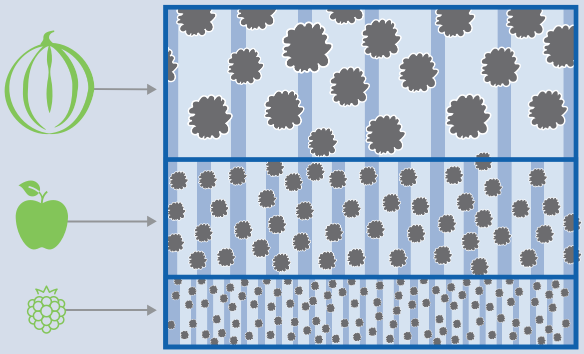
Separating mechanism at single fibre

A third valuable property of deep-bed filter media is represented by its electrostatic charge, which also mostly favours the separation of fine dust. Its disadvantage is its effect whereby fibre electrostatic charging is almost always unstable under the influence of humidity. In this case fibre charges continuously flow off and the filter media loses a part of its effect little by little. Pocket filters, which are mostly employed in the ventilating and air-conditioning system for several months, become increasingly more inefficient. DIN EN ISO 16890 limits this effect through its discharge procedure. Thus, filters of class ISO ePM1 and ISO ePM2.5 must still demonstrate an efficiency of at least 50% for their respective filter class even after all charges have dissipated.



Fibre structure with separated particles

In summary, the optimal pocket filter media has porous, voluminous filter layers of the most microfine fibres possible, which favourably may carry additional electrostatic surface charges to a limited extent. But even without these charges reliable separation values have to be guaranteed.
To manufacture such filter media exactly is technically very demanding, however, not impossible as the success of Kalthoff composite nonwoven has proved over many years. However, quality and performance have their price, knowing well that it is always possible to structure a product a little more ceaply and with less performance.
Since 1993 Kalthoff has processed composite nonwoven in its Multifold fine dust pocket filters made of electrically-uncharged, organic, synthetic fibres in its proven structure. We continuously develop these products further and adapt them to current requirements and the state of the art under the brand name Compoplus®.



Progressive depth filtration by means of Kalthoff Compoplus® filter media

WITH COMPOPLUS® TO PERFECT FILTRATION

Compoplus® filter media seperate out the finest dusts efficiently and furthermore they have very favourable pressure drops.

The Compoplus® filter layer structure is progressive. Both the fibre distances as well as the fibre diameters decrease in the direction of the clean-air side. The coarse particles are first held back on the dust-air side, then with increasing depth of the filter layer, the fine particles are also held back more and more until the necessary air purity is achieved. The entire filter media is used very economically by this gradual deposition.

For the highly effective filter layers, we use special ultra-fine meltblown nonwovens. These indicate a significantly increased separation capacity with respect to fine dusts. This has been achieved by lowering the mean fibre diameter significantly. Due to this measure the effective fibre surface is increased by approx. 150% and the efficiencies with respect to fine particles have increased considerably. Furthermore, volume and uniformity of the nonwoven were improved, so that more room is available for the dust storage.

PRODUCT SAFETY

As well as filtration performance and cost-effectiveness, the criteria of product safety also play an important role. Our pocket filter media…

- perform mechanically and the separation is stable with increased temperatures and air humidity levels.
- are made of soft and elastic filter fibres. They do not break and are not blown from the filter surface.
- are water-repellent. The danger of moisture deposition is conceivably small.
- consist of pure, chemically-inert, organic material. They are free of binding agents and they are pure white. A metabolism through microorganisms is not possible in accordance with VDI 6022.

MULTIFOLD - PROVED AND MULTIFACETED

Multifold pocket filters are offered in different filter classes (from mid ISO Coarse up to high ISO ePM1-range), where different filter media and converting procedures are employed.

For the Multifold coarse dust filter TQ 35 (filter group Coarse) and medium dust filter TCQ 60 (filter group ePM10) we process thermally-bonded, synthetic microfibers with progressive layer structure on modern stitching systems with welding technologies. In case of the medium dust filter TCCQ 65 (filter group ePM10), multi-layer composite nonwoven is used. In case of fine dust filters TCCQ 85, TCCQ 95 and TCCQ 98 (filter groups ePM2,5 and ePM1) advanced Compoplus® nonwoven is used.

The TCQ 85 and TCQ 98 series (filter group ePM1) are provided with particularly high dust-storage capabilities and lifetimes by the employment of a special voluminous filter material. They are suitable for particularly energy-efficient operation in ventilation systems.

All processing technologies guarantee maximum possible quality, security and productivity.
In addition, Multifold pocket filters are offered in different types, which are basically differentiated in the frame construction. Numerous special versions are part of everyday filter use.

THE SERIES TCCQ
KALTHOFF'S STANDARD FOR SUCCESS

- galvanized sheet steel frame
- welded filter pack fixed jointed on metal bars with the frame
- coarse / medium / fine dust filters with spacers
- spacers and outer contours running conical over the bag length
- optimized pocket number for the respective filter media

QUALITY

Compliance with the high performance level is checked regularly during individual production stages and in the laboratory. As a result, we guarantee our customers the durable, high product quality of all Kalthoff air filters. In addition, there are test certificates from independent institutes available, which additionally serve to verify our factory testing.

SERVICE

Our extensive filter stock enables a short-term delivery service for many usual standard products, which is optimally supported by our own vehicles.
In addition, we fulfil further demands on valuable logistics, such as e.g. customer- and/or object-related labelling and packaging, just in time delivery.

Kalthoff Luftfilter und Filtermedien GmbH
Gutenbergstraße 8
Tel.: + 49 2592 965 0
www.kalthoff-luftfilter.de
59379 Selm
info@kalthoff-luftfilter.de