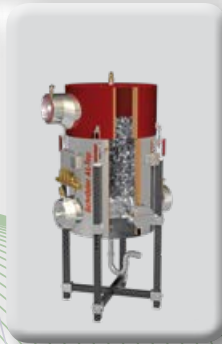


AVOIDING FINE DUST EMISSIONS

Particle separator for biomass combustion



Objective: Reduction of the fine dust emissions of small and medium-sized firing systems



Air pollution has reduced significantly over the past decades. However, fine dust loading still remains a problem which is not caused by road traffic but from wood-fired systems, with a share of approx. 25 per cent*.

In the meantime, strict limit values for dust emissions apply in many regions. In Stuttgart, there is even a possibility of banning the use of firing in separate rooms.

With the use of fine dust filters however, the dust emissions can be reduced significantly.

* 2010 in Germany





Wood –
The oldest heat source...



For thousands of years humans have been using fire to prepare meals, for heating and for melting metals. Next to grass and leaves, wood was initially used as fuel. With the beginning of the industrialisation in the 19th century, the increasing demand for energy was being covered more and more by coal and crude oil.

Increasing prices for fossil fuels and the knowledge that the supplies for oil and coal will be exhausted one day have resulted in a growing demand for renewable energy. With more than 50 percent, bio-



mass has the highest share of renewable energy in Germany.

The use of wood for heat generation is however, in a conflict area between climate and environmental protection. The energy generation from biomass emits less climate-damaging CO₂ than this is the case with the combustion of fossil energy sources, but on the other hand, the fine dust emissions are significantly higher than with firing gas or oil.

Fine dust

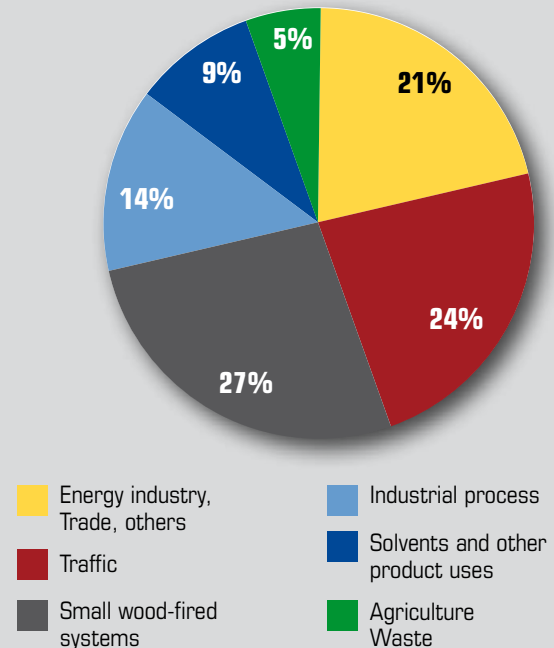
Being a natural component of air, dust is present everywhere. In doing so, smaller particles in the air are designated as suspended particles. Due to their small size, the dust particles keep on swirling up and remain in the atmosphere for days or weeks before they are washed out by precipitation.

Fine dust is mainly generated by all unfiltered industrial and combustion processes (industry, trade, power plants, households, road traffic).

The definition for fine dust is based on the National Air Quality Standard for Particulate Matter (designated as PM Standard) from the US Environmental Authority EPA. According to the definition of the EPA from 1987, fine dust designates the mass of all particles contained in the overall dust whose aerodynamic diameter is smaller than 10 μm .

An assessment of the health impact of fine dust by the World Health Organisation (WHO) has shown that an increased PM 2.5 loading is associated with severe health effects. These effects range from respiratory symptoms such as coughing to the steady

PM_{2.5} – Emissions in Germany 2010



growth in asthmatic attacks up to lung cancer. Next to that, is also assumed that this may have an effect on cardiovascular diseases (e.g. heart attack), that may lead to a significant reduction in life expectancy.

(http://www.euro.who.int/data/assets/pdf_file/0003/74730/E83080.pdf.)

Composition of the suspended particles

Soot

Particles, predominantly from carbon, generated by the incomplete combustion process



Dust

Finely distributed solid particles, generated by mechanical processes of from swirling up



Smoke

Finely distributed solid particles, generated by chemical or thermal



Suspended particles

Classification of dust according to particle size, inhalation

suspended particles



Coarse dust
 $\varnothing > 10 \mu\text{m}$



Inhalable fine dust
PM 10
 $\varnothing < 10 \mu\text{m}$



Is inhaled to the larynx (Adams apple) to the airway



Respirable fine dust
PM 2,5
 $\varnothing < 2,5 \mu\text{m}$



Enters the bronchi deep in the lungs



Ultra-fine particles
ultra-fine dust
UP
 $\varnothing < 0,1 \mu\text{m}$



Particle $< 0.1 \mu\text{m}$ penetrate to the bloodstream

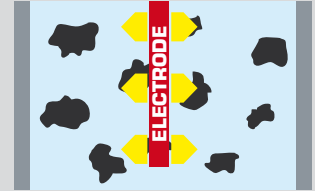
Fine dust filter: The principle

The fine dust filters from Schröder are based on the electronic principle.

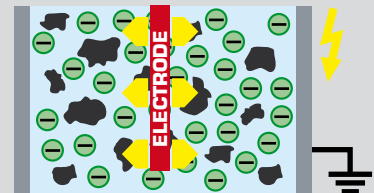
The dust emissions generated during the combustion of wooden pellets, firewood or woodchips enter the flue gas tube with the flue gas. The **OekoTube** releases a high-voltage electronics there, which moves to the wall of the chimney by means of electrostatic force. In the process, the fine dust particles are charged and also moved to the chimney wall. There, the fine dust accumulates and forms clumps to coarse flakes. These deposits are removed by the chimney sweep during the regular cleaning.

With the filters for larger firing systems, the chimney wall is not used as a separating surface, special separation media is used for this. The cleaning is carried out fully automated – either with water (AL-Top and Filterbox) or mechanically by vibration (Filterbox S and Filterbox SZ).

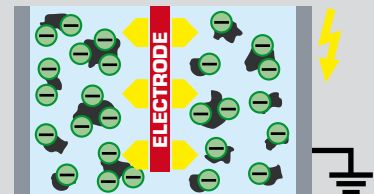
01 Fine dust particle flow through the flue channel with the exhaust air



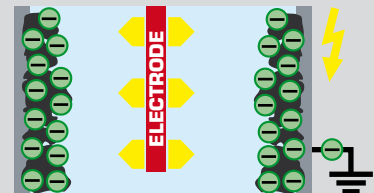
02 The **OekoTube** releases a high-voltage electronics there, which moves to the wall of the chimney by means of electrostatic force.



03 The electrons move to the wall of the chimney by means of electrostatic force. The fine dust particles are charged and also moved to the chimney wall.



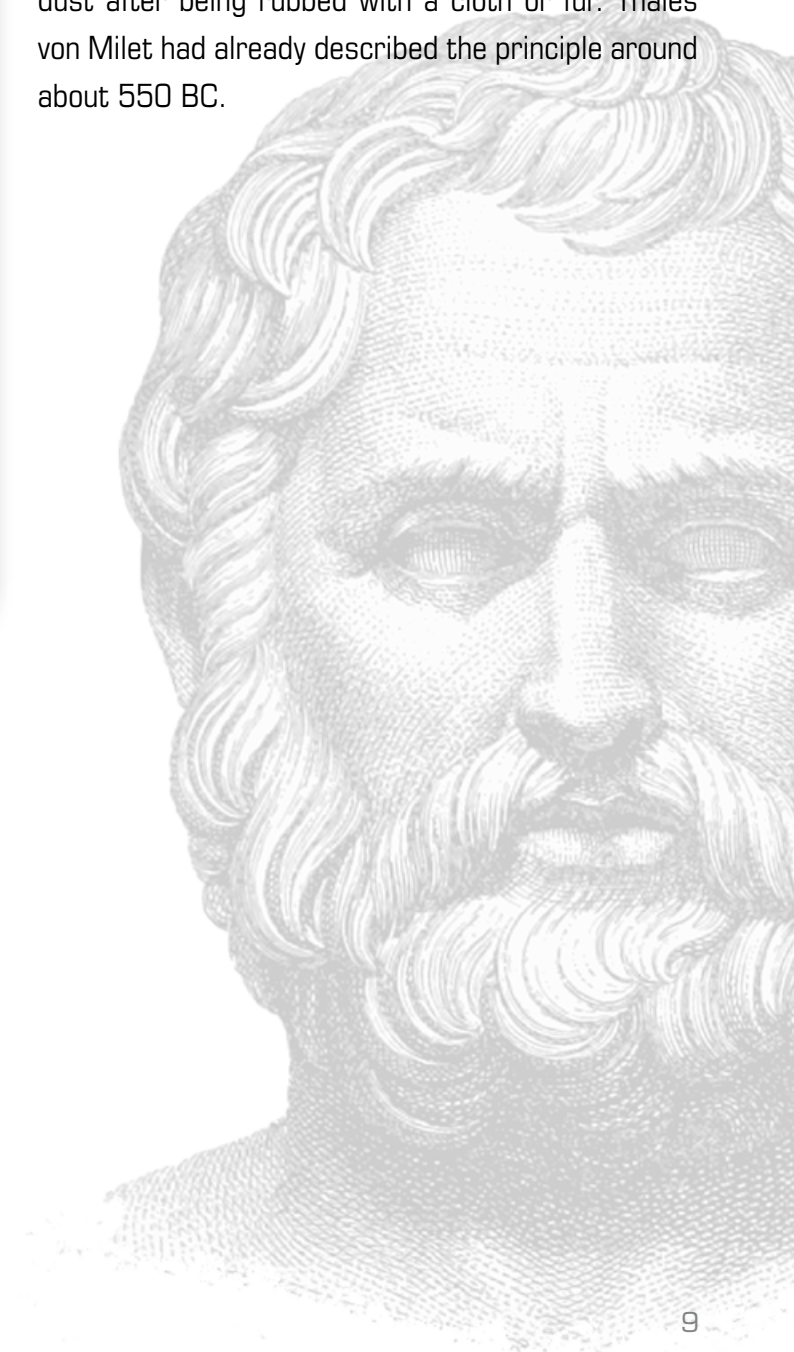
04 The fine dust accumulates on the chimney wall and forms clumps to coarse flakes. These deposits are removed by the chimney sweep during the regular cleaning.





In ancient times it was already known that certain materials such as amber (large electron) attracts dust after being rubbed with a cloth or fur. Thales von Milet had already described the principle around about 550 BC.

Fine dust adheres to the separating surface and the electrode. With an increasing dust loading of the electrode, the intelligent regulation adopts the flow values in order to maintain the separation performance.



The matching filter system for every fireplace

Schröder offers different model versions for a nominal output range from 4 to 1,200 kW:

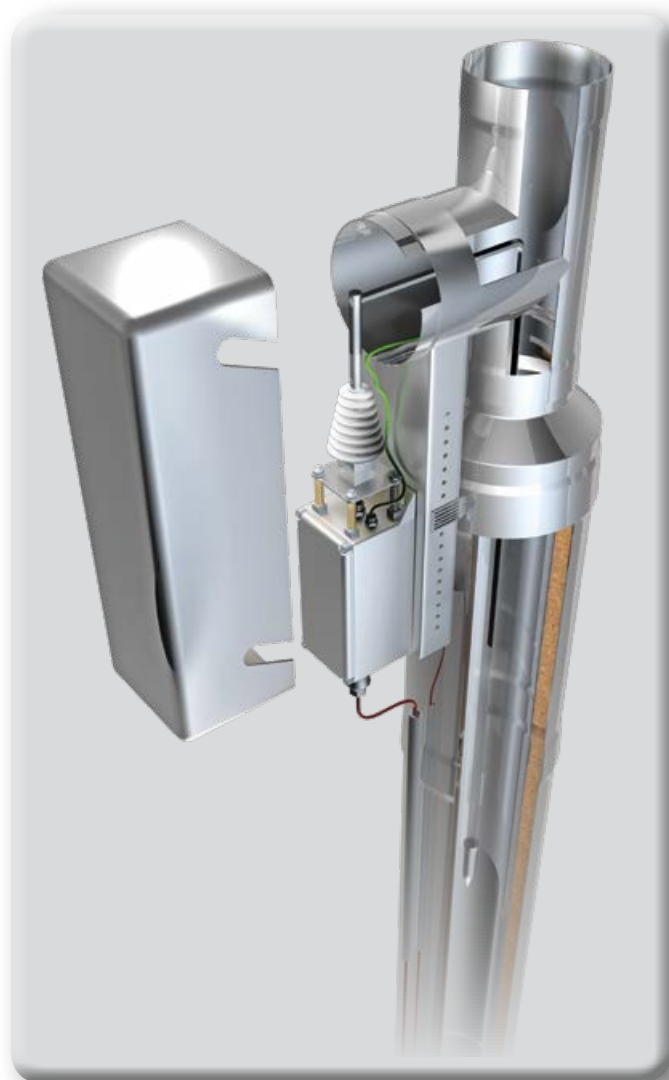
OEKOTUBE

The OekoTube is suitable for a firing performance of 50 kW and thus in particular for single room firing, such as fireplaces, fireplace inserts, tiled stoves and pellet stoves. Assembly is completed in no time at all. The OekoTube is installed in the outlet area of the flue gas system. You only need a power connection to supply the filter.

The OekoTube has proven itself in practice for many years. The matured and tested technology ensures for a trouble-free operation: when firing, the device switches on via a temperature sensor. After firing, the device switches into standby mode automatically and thus consumes less than 1 Watt.

OekoTube benefits:

- **Higher separation efficiency: up to 85 %**
- **For single room firing up to 50 kW**
- **Temperatures up to 400°C**
- **No tension or pressure loss**
- **For new installation and retrofitting**
- **Simple assembly**
- **High availability (short delivery times)**
- **Favourable price - price-performance ratio**
- **Low maintenance and operating costs**
- **No cleaning in the living area**
- **Automatic operation**
- **Robust design**
- **No wear parts**
- **German DIBt certificate**



OEKOTUBE-inside

The OekoTube-inside differs from the OekoTube only in the installation location: Instead of the chimney outlet, the Oeko-Tube-inside is installed as connecting element between the boiler and the flue gas system in the boiler room. It is supplied as finished assembly, where the alignment of the electrode is omitted. The isolator is disconnected from the control electronics. The control electronics is installed on a wall near to the filter.

Due to the spring bearing of the isolator and the flexible electrode, it is possible to clean with a chimney brush without disassembly. For this purpose, it is sufficient to plan the cleaning opening near to the OekoTube-inside.

OekoTube benefits:

- **Higher separation efficiency: up to 85 %**
- **For single room firing up to 70 kW**
- **Temperatures up to 250°C**
- **No tension or pressure loss**
- **For new installation and retrofitting**
- **Assembly in the boiler room**
- **High availability (short delivery times)**
- **Favourable price - price-performance ratio**
- **Low maintenance and operating costs**
- **Easy to clean by the chimney sweep: the electrode does not have to be disassembled.**
- **Automatic operation**
- **Robust design**
- **No wear parts**



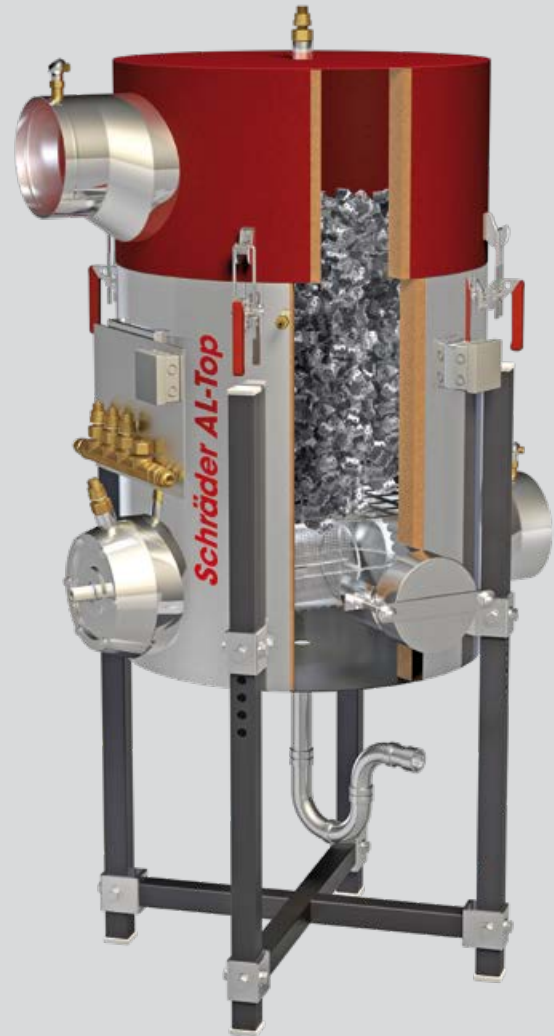
AL-TOP

The Schröder AL-Top is an electrostatic fine dust separator for biomass firing up to 300 kW. Up to 80 percent of the fine dust is separated.

The dust emissions generated when burning wooden pellets, firewood or woodchips are charged electrostatically when entering the AL-Top and deposited on the subsequent filter filling. Cleaning of the filter loading is carried out fully automated by spraying the filter filling with water; this does without the periodic cleaning and disposal of the dust required by other electric filters.



University of Otago, Dunedin in New Zealand: here, heat is generated using a woodchip stove. The AL-Top from Schröder reduces the fine dust emissions of the central heating.



DIE FILTERBOX

The Filterbox is suitable for wood firing systems in the power range from 300 to 600 kW. The electrostatic fine dust separator is installed directly behind the firing support in the flue gas line. It is characterized by its rectangular and compact design. Cleaning of the filter filling and electrode is carried out fully automated. Nozzles are fitted on the individual module that are used to spray water for removing the fine dust deposits. The cleaning interval is determined depending on the intensity of operation of the boiler as well as the fuel quality. This ensures for a fault-free operation.



Hotel Los Jameos Playa, Lanzarote: two pellet boilers for the basic load and one gas boiler for peak loads ensure for the hot water supply of the system. The Filterbox 4K 300 from Schröder ensures for clean air.



DIE FILTERBOX-S

In the Filterbox-S - available up to 400kW - the flue gases are initially sorted according to the flow and guided over the bypass downwards by the inlet support. They flow through stainless steel tubes in which the electrostatic charging as well as the particle separation takes place. The flue gas cleaned in this manner then access the chimney. Depending on the fuel as well as the state and operation of the firing, the degree of separation is 80 to 90 percent. The cleaning of the electrodes and the separation surfaces is carried out automatically with the Filterbox-S using a shaking mechanism (dry cleaning). During the cleaning procedure, the dust falls into a collecting container.

The modular 100 kW units can be assembled compact at the place of installation („Suitable for standard doorways“). We also recommend the Filterbox-S for retrofitting.



Cleaning and maintenance work can be carried out without much effort using the cleaning and maintenance openings. The soiled separator unit can be replaced by a new processed unit with new electrodes within a few minutes. This allows downtimes to be kept particularly short.



DIE FILTERBOX-SZ

The Filterbox-SZ is a dust separator with modular design for large-scale wood-fired systems. The Filterbox-SZ combines two proven separating principles: an electrostatic particle separator is located upstream from a cyclone.

The outstanding geometry and the excellent flow behaviour within the Filterbox-SZ are the result of computer aided simulations during the development. First the flue gases are guided through the cyclone that separates the coarse dust.

The small dust particles are then charged electrostatically in the downstream module via electrodes and separated. The cleaning of the electrodes and the separating surface is carried out automatically using a shaking mechanism. As with Filterbox-S, the dust falls into a collecting container.

As the coarse dust has already been separated in the first module, the interval for cleaning the electrostatic module and the effort for maintenance is reduced significantly.





Since the 1980's, Schröder has been developing and producing flue gas lines made of stainless steel and today, is one of the leading manufacturers of chimney technology made of stainless steel in Germany. In 2008, Schröder had addressed the topic air pollution control and energy efficiency. The range of products now also includes fine dust filters and heat exchangers.

With the fine dust filters for wood combustion developed by Schröder, a reduction of the dust emissions of up to 90 % is achieved.

With the topic energy efficiency, Schröder has put their focus on thermal recovery from flue gases. The enormous potential that is offered by trade and industrial process heat is not being exploited by far. In the first line, it is the industry leaders that have already recognised and are using the potential savings.

In doing so, an investment may already amortise after one year. Current Schröder employs approx. 70 members of staff in Kamen (North Rhine-Westphalia) and in Badrina (Saxony).