General Description

Biofilter

1. Biofiltration

Due to its process-integrated biological regeneration the biofilter technique is an effective method for odor elimination and treatment of low concentration or undefined exhaust air streams. This advantage is realized due to the natural reactions of the biological degradation of contaminants. It takes place at:

- ambient temperature
- neutral pH and normal pressure
- produced no problematic final products
- is odor neutral

2. Principle of operation

Technically a biofilter is a bulk layer of organic dampened material through which the exhaust air flows slowly through in order to be treated. It naturally contains a microflora that increases under appropriate environmental conditions and adapts to the degraded exhaust components.

The exhaust components are separated by sorption at the filter material and dissolved in the contained moisture film while it flows through the organic bed. The dissolved air components reach into the microorganism cells by diffusion and osmosis and degrade it to ecologically non-relevant compounds. The functionality of the biofilter essentially depends on the sorption capacity of the biofilter and the biological activity of its bioflora. Their properties and activities are determined not only by material properties, but also by the forthcoming exhaust parameters. These include:

- the temperature of the water vapor-saturated air (ideally between 15 and 40 °C)
- the water vapor saturation of the air to be treated (close to the saturation point)
- the concentrations of pH-related exhaust components (as low as possible)
- the concentration of dust and liquid aerosols (such as fat, resin or lubricant), (as low as possible)
- the content of toxic or accumulating exhaust components (e.g. heavy metals) in negligible concentrations

The service life and functionality of the biofilter can be guaranteed only if these exhaust parameters are set correctly.

Biofilters are mainly applicable in the following fields: sewage treatment plants, composting, mechanical-biological waste treatment, food production, manufacturing leather and tobacco processing.

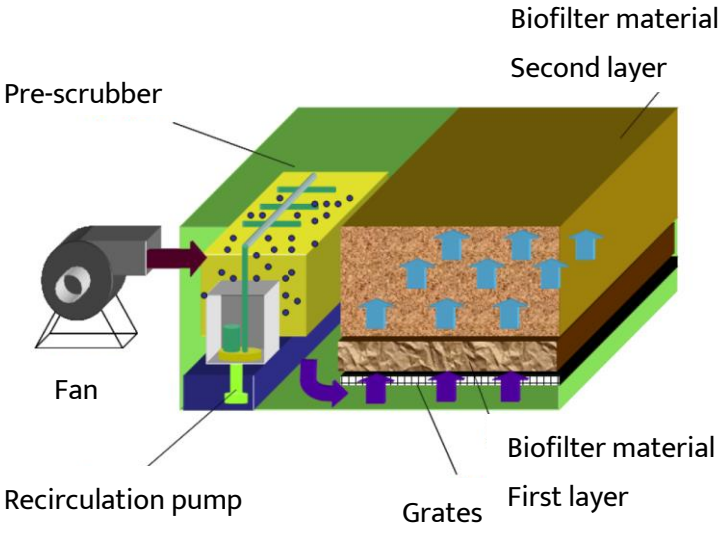

Fig. 1: Principle

3. Biofilter material

We use a mixture of organic material as a substrate for the bacterial flora that is well structured and does not collapse. The pressure drop remains constant over a long time.

In our biofilter two layers are used with different filter media:

- The first layer should guarantee an optimal distribution of the incoming exhaust air and direct it homogeneously onto the overlying filter layer. In addition, the bottom layer is used to start rotting fine particles without condensations occurring. Our material used for the base is cracked root wood. This is characterized by a high mechanical support function as well as a large surface area and thus additional habitat for the degrading microorganisms.
- The second layer is a special mixture of organic material. It serves as a support substrate and adds missing nutrients for microorganisms into the raw air. At the same time, this mixture is also sufficiently resistant to biodegradation and ensures a constant flow. Compaction and channeling in the filter bed can thus be further prevented.

The filter mixture provides a very low pressure loss and high water storage capacity. It also has a high buffering capacity and can thus maintain a pH value optimum for the microorganisms.

With correct operation, our biofilter provides a very long lifetime. Under optimum conditions, operating times of 3-5 years can be accomplished without material change.

Fig. 2: Root wood

Fig. 3: Pine bark with wooden parts

4. Parts of the system

4.1 Materials

The biofilter housing, the scrubber housing, the circuit line and all parts that are exposed to the exhaust air or the wash water (packing, gratings, etc.) are made of corrosion-resistant plastics. High dimensional and chemical resistance as well as a long lifetime characterize this material.

Our biofilters are completely made from fiberglass-reinforced plastic (FRP). This is handcrafted from high-quality polyester resins using glass fiber mats, glass fabrics and fleeces. The walls are made of a sandwich construction with a PU foam core. As a result, a high dimensional stability with minimal weight is achieved. At the same time, this wall structure serves as an insulator, whereby the condensate formation in the marginal zone of the filter material is avoided.

The prefabricated parts can be easily assembled into a finished biofilter. Due to its modular design, the system can be added or expanded later on.

The inside of the biofilter and the washer is equipped with a protective coating against the chemicals. The outer skin is pigmented and interspersed with UV absorbers. As a result, the scrubber housing is permanently protected and is characterized by longevity.

4.2 Pre-scrubber

The reason for a pre-scrubber before the biofilter is to achieve an optimum preconditioning of the exhaust air. Herewith the gas flow is set to the operating parameters necessary for the microbiological treatment. Primarily this is the humidification of the air to nearly 100% relative humidity in order to guarantee an adequate liquid film whereby the air cools down to the dew point.

In addition, the dust and dirt must be removed from gases to prevent fouling of the carrier material and a clogging of the biofilter material.

A chemical pre-treatment of exhaust air may be necessary to ensure an optimum pH value in the liquid film or constant ambient conditions for the bacterial flora

In order to effectively compensate load peaks in the exhaust stream and thus ensure high safety reserves, the recirculating wash water in the pre-scrubber is also used as a buffer and to achieve constant conditions for the microorganisms in the biofilter.

4.2.1 Recirculated wash water

The wash water is constantly circulated in the pre-scrubber. The pump sucks the scrubbing liquid out of the scrubber sump and discharges it through the circuit line to the nozzle. There the spiral full cone nozzles spray the washing water constantly over the packed bed. It trickles through the packing and brings the exhaust air stream to the operating conditions specified above.

4.2.2 Recirculation pump

An extremely robust and corrosion resistant plastic vertical chemical pump is used as a recirculating pump. All wetted parts are tailored to the specific requirements of the partly aggressive or abrasive wash water. At the same time, the exhaust contaminants and the accompanying reagents, which are converted into the liquid phase, are considered.

In general, submersible pumps with dry erected engines are used. These pumps are bolted on specially designed pump suctions boxes, which are positioned directly on the scrubber housing.

4.2.3 Packing

Due to their large active surface, which is wetted by water, the packing has the task to saturate the exhaust air. Simultaneously, the transfer of pollutants into the washing liquid is increased.

With the used packing there are about 100m^2 surface per m^3 package available. Because of the special design of the packing (open frame, large active surface) many small washing liquid drops are split and reformed. During the process, the droplet surface is constantly renewed and can therefore absorb more pollutants.

4.2.4 Eliminator

Arranged behind each packed bed is a mist eliminator. It has the task to separate the entrained washing liquid droplets from the air stream. The used eliminators are characterized by a high degree of separation with low pressure drop and low risk of clogging.

4.2.5 System Control Technology

In general our pre-scrubber is equipped with the following measuring and control devices:

- Level control in the washing water sump with automatic fresh water supply
- Dry run protection for circulation pump
- Pressure gauge for monitoring inlet pressure of the nozzle
- Sump heater with thermostat in the case of frost danger

In addition, the following control elements are available:

- pH control in the case of dosing of acids or bases

Optionally on request are available:

- Water meter for the registration of fresh water consumption
- Temperature monitoring in the case of hot exhaust gases

- Pipe heating for outside pipes
- Exhaust air volume flow measurements
- Fan speed monitoring
- Control of under pressure
- Raw and clean gas analysis
- Operating hours counter for all drives
- Flow monitoring for circuit line
- Dosing station

4.2.6 Dosing Station

Due to the expansion of the pre-scrubber with a dosing station, it is possible to set a pH value for the wash water. Thereby air pollutants such as ammonia or hydrogen sulfide can be washed out in front of the biofilter in case of a high load. Thus, acidification of the biofilter can be avoided.

In case of dosing of acids (sulfuric acid) or alkaline (caustic soda) accordingly dimensioned dosing pumps are used. In general, these are magnet-operated diaphragm pumps. The wetted materials are adapted to the used chemicals.

The dosing pumps are driven by the generated signal from the pH measurement. Due to the automatic mode of operation, only the actually used chemicals are to be replenished.

Fig. 4 and 5: Standard Biofilter