ODOR CONTROL TECHNOLOGY SUMMARY

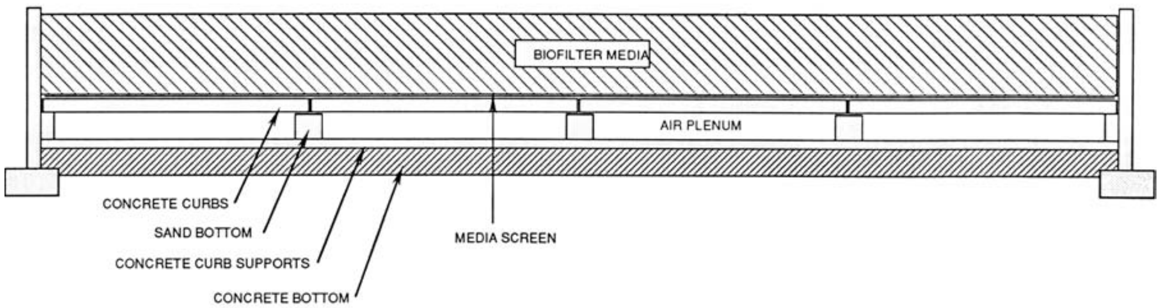
Technology: BIOFILTERS

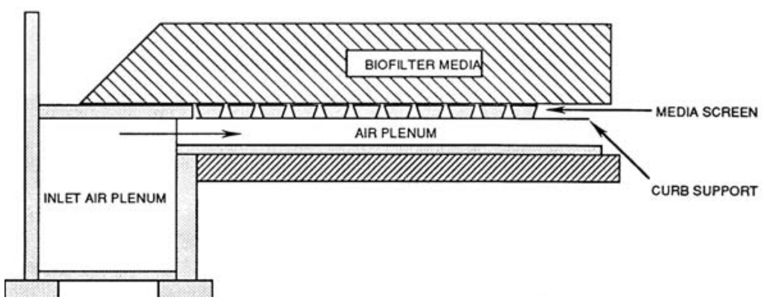
Description:

Biofilters are an odor treatment technology that utilizes biological processes as the treatment mechanism. Biofilters are considered to be a “green” approach to odor control, because they utilize microorganisms in media to oxidize odor and air emission compounds to carbon dioxide, water, biomass, and other benign by-products such as chloride and sulfate. The by-products are either emitted in the outlet air, drained from the biofilter, or consumed by the microorganisms. The biological activity in a biofilter is similar to the activities performed by the microorganisms in activated-sludge secondary wastewater treatment processes.

Biofilter (organic media)

Typical biofilter sections are shown below. Biofilters work by routing odorous air through a porous filter media. The media represents the contact surface area, on which the microorganisms live, where the biological oxidation described above can take place. The key to effective biofilter operation is maintaining a healthy environment for these microorganisms to thrive in. The most important parameters for maintaining a healthy environment is moisture content and pH. The microorganisms need water to remain active, and the presence of water effects the transfer of the contaminants from the air to the media. The desired microorganisms thrive at neutral to moderately acidic pH levels.





Biofilter Sections

Biofilters are less control-dependent than chemical scrubbers, because the treatment system is more self-regulating. It is essentially a self-contained ecosystem, and is therefore likely to function longer, without excessive control. It is very important, however, to ensure moisture levels are controlled in the biofilter for it to function properly. Moisture content is assisted during dry periods by simple sprinkler systems and air humidification. The pH levels are often self-regulating within the ecosystem, and are assisted by proper choice of media. However, the reaction products in a biofilter treating hydrogen sulfide is sulfuric acid so preventing the formation of a very low pH is important and design should include corrosion protection on concrete and other materials.

Biofilters are typically good applications in dilute waste streams, like those typically found in wastewaters. The biggest drawback to this technology is the relatively large space requirement, compared to the technologies mentioned above. However, modular biofilter designs using synthetic, inorganic media require a much smaller footprint than the open-bed designs. Biofilters may also use more power than chemical scrubbers, but do not involve any chemical handling or storage.

Biofilter (modular, inorganic media)

Air streams with high concentrations of reduced sulfur compounds (RSC's) such as mercaptans, dimethyl sulfide, dimethyl disulfide, diphenyl sulfide, carbonyl sulfide, and carbon disulfide can be treated in biofilters but the loading rates must be much lower than those required to treat H_2S.

Biofilter media types include wood-chip/bark media, soil media, and inorganic synthetic media.

Wood-chip/bark media generally possess a large diversity and density of microorganisms, accepts moisture relatively well, has low initial costs, and is readily available. The normal lifetime for wood-chip/bark media is 2 – 4 years.

Soil media is a blended mix of soils, primarily sand-based. The primary advantage of soil media over wood-chip/bark media are their life expectancy. Soil has an estimated lifetime of over 30 years as a filter media. Soil is denser than wood-chip/bark media and therefore resists compaction, it resists acidification because of it's inherent pH buffering properties, it is less difficult to rehydrate after drying out, and generally distributes the air more uniformly than wood-chip/bark media. The primary disadvantage is that it requires a smaller loading per square foot, and therefore may require a larger footprint and higher initial capital costs.

The inorganic synthetic media is newer to the market but well tested. It consists of strong, uniform sized gravel-like cores that do not compact as easily as organic media. This type of media may be used in the modular designs because it allows greater media depth and a smaller footprint. The cores are commonly coated with nutrient rich organic and inorganic adsorbents. The media typically comes with a 10 year life guarantee.

Applicable Treatment Processes:

All liquid treatment plant processes, pump stations, sludge thickening, sludge dewatering.

Typical Design Criteria:

Surface Loading (Wood-Chip media)	3 - 4 cfm per sf media
Surface Loading (Soil media)	2 cfm per sf media
Inorganic, synthetic media	10-12 cfm/ft^2
Media Bed Depth (Wood-chip/Soil media)	3 ft.
Media Bed Depth (Inorganic, synthetic media)	5 ft.
Detention Time (Wood-chip/Soil media)	$\geq$ 60 seconds
Detention Time (Inorganic, synthetic media)	20 - 30 seconds
Pressure Drop	6" – 12"
H_2S removal efficiency	99%

Major Design Considerations:

a. Methods of air flow distribution and media support:

Air flow through the biofilter may be distributed by several methods. The outer walls of the air plenum may be formed by earth berms, concrete walls, or other support mechanisms. A plenum lining provides for proper drainage of the biofilter. The air plenum below the media bed may be open air space formed by the walls with grating forming the top, with railroad ties forming the support and top of the plenum, or it could be formed with perforated air distribution piping buried in a coarse rock bed. If a rock bed is used, special consideration must be given to the type of rock. Limestone and other soft rock can not be used because it breaks down in the acidic environment and may obstruct air flow.

b. Media selection

Media may be purchased from manufacturers, or blended based on a recipe from locally available media constituents, such as wood chips, bark, and various soil media constituents. Media replacement frequency is affected by media selection, as mentioned above.

c. Moisture Control

Moisture control may be accomplished by pre-humidification of the air in a mist chamber with spray nozzles, with a packed tower humidification chamber, by keeping the media wet using soaker piping within the media bed, surface irrigation with spray nozzles, or a combination of these methods. Moisture sensors have not proven to be extremely reliable, therefore manual operator monitoring is typically used to ensure adequate moisture content.

d. Loadings

Loading of biofilters should be properly designed to prevent acid formation, corrosion problems, premature compaction of the media, short-circuiting the media bed, inadequate biological activity, and other problems which can result in sub-standard performance of the biofilter.

e. Corrosion Protection

Due to the formation of sulfuric acid as a byproduct in hydrogen sulfide treatment, the following corrosion protection should be included in the biofilter design:

- Liners or protective coatings on concrete
- Installation of pH probes in drain water to measure pH