

# ecofilter®

**Redefining Biotrickling Filter Technology**



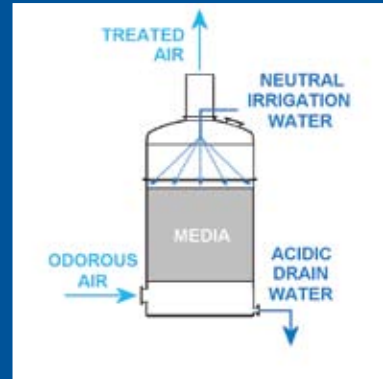
**bioair®**  
*Breathe Better.*

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# Biotrickling Filter versus Bioscrubber

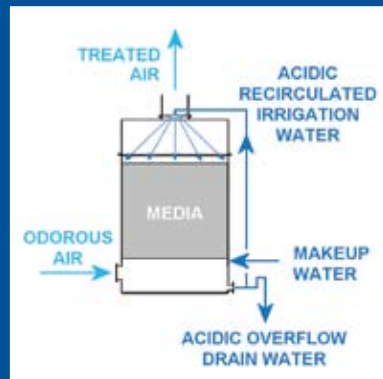
BioAir's EcoFilter is a biotrickling filter technology that provides distinct process and performance advantages over bioscrubbers. Some odor control professionals incorrectly use biotrickling filter and bioscrubber as interchangeable. The WEF Manual of Practice<sup>3</sup> outlines a clear distinction:

## Biotrickling Filter



“A vapor-phase odor control technology that uses air-permeable inert media exclusively for the growth of attached microorganisms and the direct biodegradation of odor compounds...irrigation of the media is with clean water.”

## Bioscrubber



“A vapor-phase odor control technology that uses inorganic media in a vessel for support of microorganisms or for mass transfer of odors from the vapor phase to a recycled liquid phase.”

a - MOP25 Control of Odors and Emissions from Wastewater Treatment Plants, Table 12.1, P.352.

In a biotrickling filter like those designed by BioAir, the microorganisms are attached to the media surface, so no recirculation is required. Treated effluent or potable water can be used as the irrigation water source. In a bioscrubber, the microorganisms are partly suspended in the recirculated water and partly adhere to the media. Recirculation of the water over the media is a necessary part of the process. Unfortunately this recirculation has negative impacts on performance such as inability to treat organic odors.



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## Why Fresh Water Matters

BioAir's EcoFilter products use fresh water for the removal of organic odors which cannot be treated with a bioscrubber's naturally-acidic recycled water.

Municipal wastewater odors are complex in their makeup. Although hydrogen sulfide (H<sub>2</sub>S) is often the primary odorous compound, all airstreams contain some organic reduced sulfur compounds (ORSCs), such as methyl mercaptan, dimethyl sulfide, and many other volatile organic compounds that could significantly contribute to odors.

These individual odor compounds are metabolized (oxidized) by different microorganisms. H<sub>2</sub>S, for example, is primarily degraded by autotrophic bacteria, such as *Acidithiobacillus* species, and organic odors compounds are primarily treated by heterotrophic bacteria, such as *Pseudoxanthomonas* species.

- The biological oxidation of H<sub>2</sub>S by autotrophic bacteria is:  
 $H_2S + 2 O_2 \rightarrow H_2SO_4$
- The biological oxidation of methyl mercaptan by heterotrophic bacteria is:  
 $2 CH_3SH + 7 O_2 \rightarrow 2 CO_2 + 2 H_2SO_4 + 2 H_2O$

While the oxidation of methyl mercaptan produces some sulfuric acid, its primary oxidative by-products are carbon dioxide and water. On the contrary, when H<sub>2</sub>S is oxidized, sulfuric acid is the primary by-product. Since H<sub>2</sub>S concentrations are typically much higher than the organic odor concentrations, the media bed will become increasingly acidic. Most autotrophic bacteria are acid tolerant and can survive the low pH but heterotrophic bacteria require a pH of between 6.5 and 7.5 to grow.

Because bioscrubbers recirculate low pH drain water, only autotrophic bacteria grow in the reactor. As a result, the bioscrubber can achieve good H<sub>2</sub>S removal but very little organic odor removal. Biotrickling filters use single-pass irrigation with fresh water, which allows for a pH gradient to develop in the media. This makes it possible for both autotrophic and heterotrophic bacteria to grow in the same reactor vessel; thus allowing oxidation of both ORSCs and H<sub>2</sub>S in a single system.



## Advantages of Biotrickling Filters over Bioscrubbers

Advantages of biotrickling filters over bioscrubbers include -

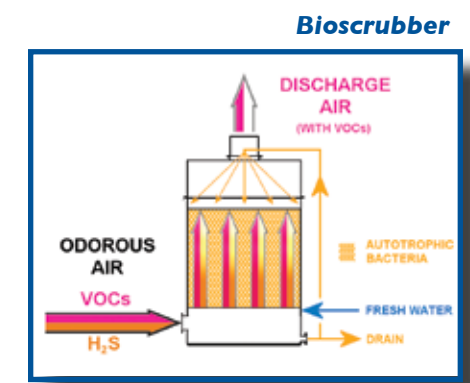
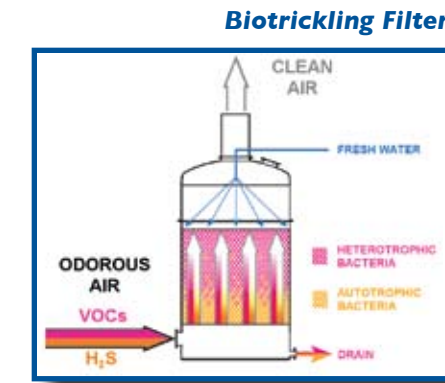
### Ease of Operation -

- No recirculation
- No pH meters
- Simplified controls
- Less instrumentation

### Lower cost of Ownership -

- Lower power consumption
- Lower maintenance cost
- Less instrumentation calibration

### Better overall odor removal



## The EcoBase™ Advantage

EcoBase structured synthetic media is establishing new performance standards for the industry.

### Uniform Media Characteristics = Uniform Performance

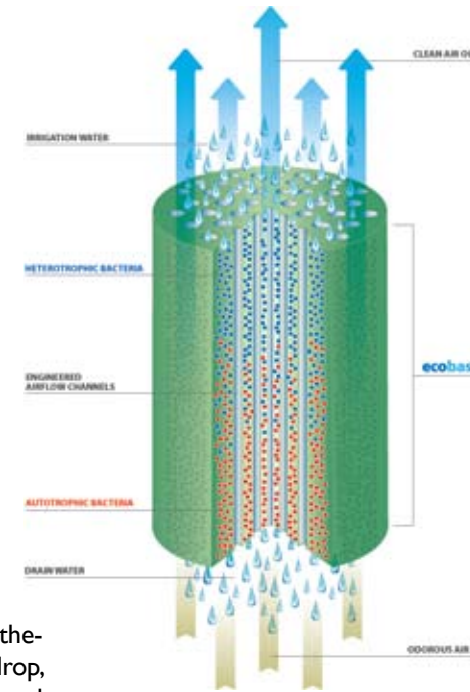
EcoBase has true, measureable, uniform characteristics that allow for uniform specific surface area, uniform flow distribution, and uniform biomass contact time.

Key advantages of the EcoFilter system with EcoBase include -

- Engineered flow channels provide uniform airflow throughout the media which optimizes contact between air and biomass.
- Uniform flow velocities eliminate channeling that leads to poor performance.
- Engineered flow channels control the degree of turbulence to optimize mass transfer of odorous compounds to the microorganisms.
- High specific surface area allows for high microbial density to treat very high odor loadings.
- Stable system performance is possible at high mass loadings (> 250 g H<sub>2</sub>S/m<sup>3</sup>.hr) and very low residence times (< 3 s).

### Random Media Characteristics = Inconsistent Performance

Many biological odor control systems utilize random media: woodchips, lava rock, or synthetic media cubes. The fact that the media is random result in variation in density, pressure drop, moisture level, and airflow throughout the media bed, making it impossible to control and optimize the process. Compared to structured media, this leads to lower overall performance, a requirement for longer residence times, and larger reactor vessels; all of which are required to compensate for the inherent variability in the media properties and process conditions.



## EcoFilter® Biotrickling Filter

BioAir Solutions has invested considerable resources to further the science of biotrickling filters:

- Expertise AND Experience - BioAir's team brings more than 30 years of combined experience directly related to the science, patenting, engineering, marketing, installation, and operation of biotrickling filter solutions.
- Research AND Development - BioAir has undertaken one of the world's largest full-scale research studies ever conducted through its installation of five (5) EcoFilter EF51 biotrickling filter systems at a wastewater facility in Florida. The scope and range of the research was broad: assessment of media surface chemistry on microbial adhesion; studying various engineered air flow channel designs on mass transfer; utilizing molecular biology tools (such as T-RFLP) to determine microbial community changes through the media bed; using DNA cloning to identify specific bacteria treating specific odor compounds, and more. Over 2 billion data points were collected and analyzed resulting in the development of BioAir's patented EcoFilter system based on our trademarked EcoBase™ media.

# EcoFilter – Doing Everything Right

EcoBase forms the backbone of the EcoFilter technology, but there are other factors that contribute to the superiority of the EcoFilter product line -

- Modular Designs are Easily Scalable**  
 EcoFilter is modular by design and easily installed in parallel to create unlimited total treatment capacity. Individual system expansion is simple and inexpensive with scalable designs; treatment capacity can be increased by stacking an additional media module on top of an already installed EcoFilter system.
- Air and Water Flow Modeling**  
 Engineering for uniformity is central to BioAir's design philosophy, not only for the EcoBase media, but also for the EcoFilter irrigation water and air distribution systems. Each EcoFilter system design is based on 3-D airflow modeling of air distribution, airflow through the media, and homogeneity of irrigation spray system. Individual units are flow tested prior to shipment to verify performance.
- Ease of Operation** With experience in the startup and operation of hundreds of biotrickling filters, BioAir engineers design for simplicity without compromising system performance. This minimizes maintenance requirements and downtime, and maximizing performance and operating time.
- Low Operating Costs** The EcoFilter system eliminates the need for expensive chemicals, and its extremely low pressure drop reduces blower power consumption. With a 20-year design media life, media replacement cost is practically eliminated. On a 10 or 20 year Net Present Worth evaluation, EcoFilter will prove to be the least expensive solution to your odor problem.

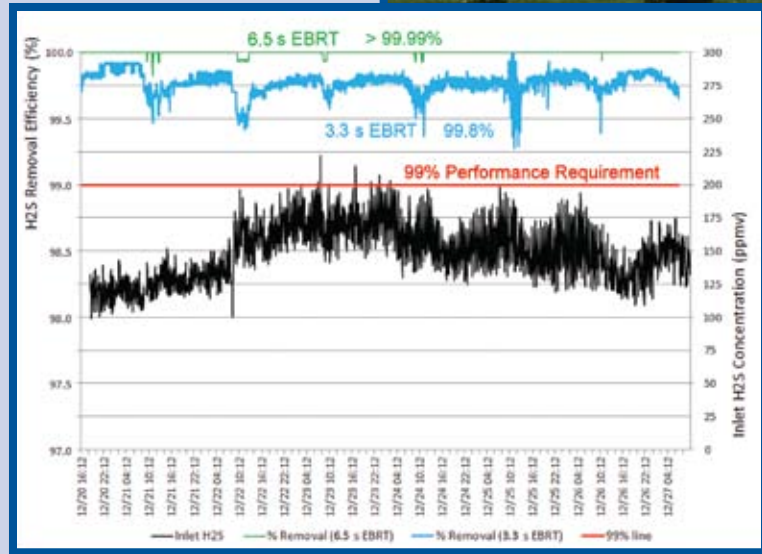
## Case Study

Equipment: .....EcoFilter® EFI242  
 Odor Source: ..... WWTP Biosolids Disposal Building  
 Empty Bed Residence Time (EBRT): ..... 3.3 seconds  
 Airflow: ..... 15,500 cfm  
 Actual Inlet H<sub>2</sub>S Treated: ..... 100-225 ppmv  
 Actual H<sub>2</sub>S Removal Efficiency: ..... 99.8% @ 3.3 seconds

An EcoFilter EFI242 was installed at the JEA Buckman Facility in Jacksonville, FL in 2011. This system provides 6.5 seconds EBRT in one reactor. Treating this high-strength H<sub>2</sub>S airstream, the EcoFilter exceeded the 99.0% performance requirement in just the lower half of the reactor. The graph shows the performance for a typical week. The blue line indicates 99.8% average H<sub>2</sub>S removal at the midpoint in 3.3 seconds. The green line indicates removal exceeding 99.99% at the reactor outlet.

**Result** – Performance of the BioFilter far surpasses requirements allowing a very large margin of safety. And the cost of ownership is far less than competing technologies. All this in the same footprint as a chemical scrubber without any chemical costs or risks.

Happier neighbors  
 Happier operators  
 A win-win solution!



	5 Series				6 Series				8 Series				12 Series			
Diameter	60"	60"	72"	72"	90"	90"	90"	90"	141"	141"	141"	141"	141"	141"	141"	
Height	9'-2"	13'-4"	10'-6"	14'-10"	11'-8"	16'-0"	21'-2"	25'-5"	15'-2"	19'-4"	25'-0"	29'-3"	35'-0"			