

**Vendor:**

**BioFiltro USA Inc.**

1959 5th Street  
Suite 101  
Davis, CA 95616  
[www.biofiltro.com/en/](http://www.biofiltro.com/en/)

**Industry:**

Wastewater filtration

**Project Type:**

BioFiltro engineer design filtration and separation technologies.

**Project Goal:**

The BioFiltro System is a stand-alone biological filtration for dairy wastewater to reduce nitrogen loading.

**Study Prepared by:**

Dr. Frank Mitloehner

**Date of Case Study:**

September 11, 2017



**Dr. Frank Mitloehner,**  
Professor and Cooperative Extension Specialist for Air Quality in the Animal Science Department at UC Davis.

## BioFiltro System (BIDA® System)

Fanelli Dairy, Hilmar, CA

### OVERVIEW

The Mitloehner lab at UC Davis conducted tests on a pilot scale BioFiltro system (also called the BIDA® System) that was installed and employed on the Fanelli Dairy farm with a capacity of 10,000-13,000 gallons per day (380 cows/day). The BioFiltro system is a passive aerobic bio-reactor, that simultaneously achieves physical and biological removal of total suspended solids and nutrients. The system at Fanelli Dairy had a foot print of 5,802 ft<sup>2</sup>. At a hydraulic retention time of four hours, the removal of ammonia and total Kjeldahl nitrogen was 85% and 74%, respectively. The system reduced NH<sub>3</sub> gas emission from dairy wastewater by 90.2% without substantially increasing other emissions. The system effluent can be used for manure flushing on the dairy or for irrigation. Biofiltro applies the 'Wastewater as a Service' financing model in which they charge 1.1-1.5 cent per gal of treated wastewater (\$162/cow annually).

### BACKGROUND

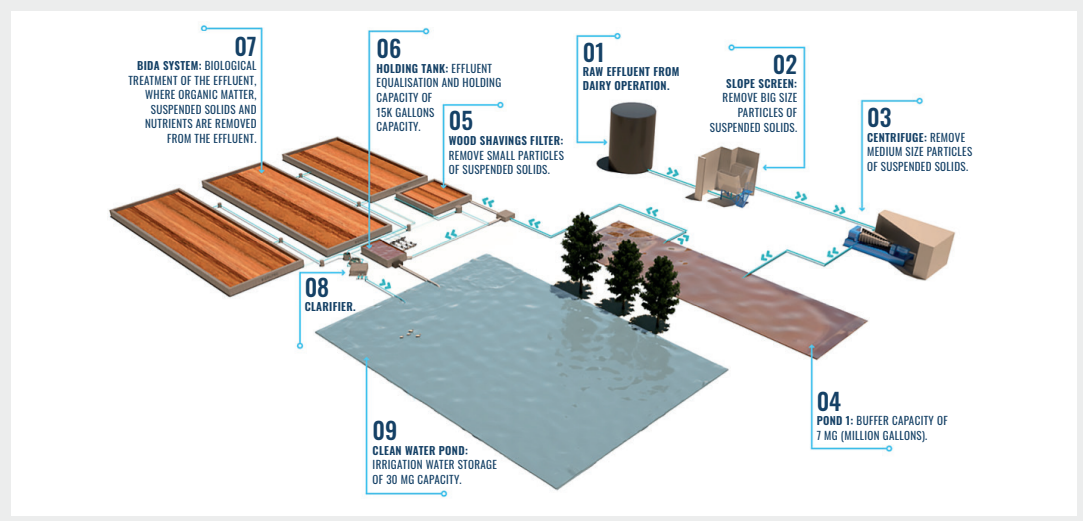
**BioFiltro contains woodchips seeded with earthworms and microbes to drastically reduce lagoon nitrogen.**

A pilot scale BioFiltro system was designed and installed on Fanelli farm, located in the central San Joaquin Valley, CA. The farm has approximately 760 milking cows and 1,300 head in total. The dairy applied a manure flushing system to remove manure from the barn. The average flow rate of wastewater

was 27,000 gallons per day. The flushed wastewater was stored in an uncovered anaerobic lagoon.

The BioFiltro system is a passive aerobic bio-reactor, that composed of a concrete container with a layer of woodchips seeded with earthworms and microbes that simultaneously and symbiotically work to form a robust and dynamic biofilm. The system was applied to treat approximately 50% of the wastewater produced on the farm. Prior to reaching the BioFiltro system, the lagoon water went through

### Integration of BioFiltro system with manure management system on dairies.



a rotary screen to remove most of sand and solids because high solids, especially inorganic solids, negatively affect the flow through the system. The separated wastewater with relatively low suspended solid contents of 1500 mg/L was then evenly dispersed on top of the filter surface. The solid removal prior to application onto the BioFiltro seems to remain the major challenge for this technology as the sprinklers easily plug up leading to uneven application of lagoon water onto the filter surface.

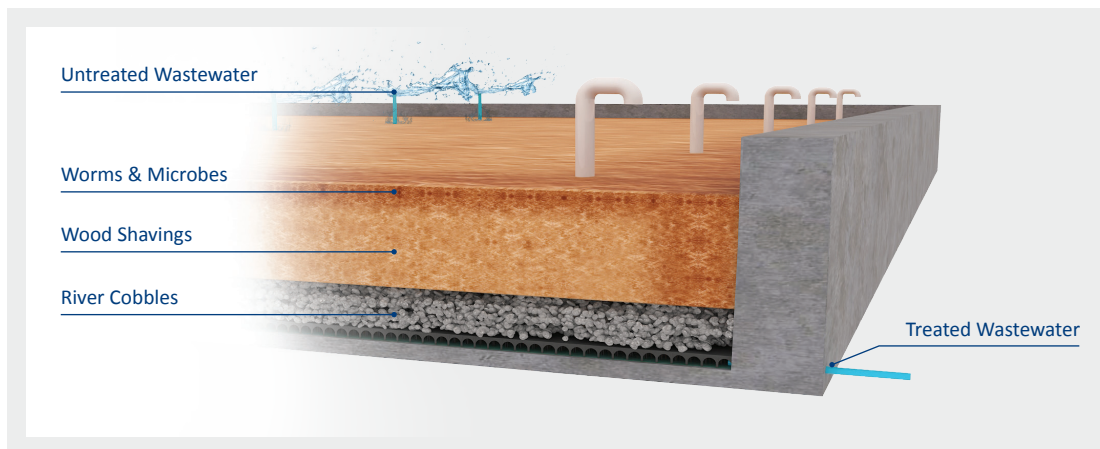
Once wastewater has been sprinkled onto the filter, it percolates through the filter, where it is physically filtered and biologically treated in a short four-hour hydraulic retention time. The effluent is collected in an underground storage tank until used for manure flushing on the dairy freestall barn or for irrigation.

### KEY LEARNINGS

#### BioFiltro achieves high efficiency physical and biological removal of nitrogen.

- The BioFiltro system can achieve high efficiency nitrogen removal for wastewater with low suspended solid contents
- The filter system bottom consistently emitted less gas than its top, most likely due to nutrient adsorption and conversion in the woodchip layer
- The reduction in ammonia (NH<sub>3</sub>) emission was due to the efficient adsorption of NH<sub>3</sub> by the bio-reactor and subsequent microbial transformation of NH<sub>3</sub> through nitrification and denitrification
- Air emission rates peaked in the afternoon due to the increased temperatures
- To alleviate the effect of the afternoon high temperature on the emission, a geotextile can be used as a sunshade and hung over the top of the system.

### Parts of the BioFiltro System



### KEY BENEFITS

#### The BioFiltro system is scalable and has high removal rates of nutrients with a small footprint –

The system can be applied on dairies with different wastewater flow rates (2,000 to 200,000 gallons/day). BioFiltro can be integrated with primary solid separation technologies (e.g., rotary screens) to treat high strength wastewaters (TSS of up to 30,000 mg/L, and TKN of up to 2,500 mg/L) at a hydraulic loading rate of 2.5 gallons/ft<sup>2</sup>/day.

#### The BioFiltro system has positive environmental impacts, low maintenance requirements, and long life –

BioFiltro emits low amounts of ammonia and GHG, and achieves high removal of TKN via nitrification and denitrification that results in positive impacts on air, soil, and ecosystems. Major maintenance is needed every 15 months to remove the top layer of media that is rich in worm castings that can be sold, mainly for horticulture applications. The cast can be removed by an excavator (or a similar scraper), then screened, and dried before marketing. It is estimated that the system has a life time of 25-50 years.

**The BioFiltro system is cost-effective –** BioFiltro provides a novel financial model called Wastewater as a service (WAS) that is an operating lease in which BioFiltro is the owner of the asset for the duration of the contract that is averaged at 10 years. Through the contract duration, BioFiltro charges 1.1-1.5 cent per gallon of treated wastewater without upfront costs. BioFiltro covers all the operational and maintenance costs for the life of the contract. BioFiltro offers the option to buy out at any time during the contract.

### Key Benefits & Results:

- BioFiltro can be a promising environmental solution for dairy wastewater management.
- BioFiltro is scalable and has high removal rates of nutrients at small footprints.
- BioFiltro achieves physical and biological removal of nutrients in short retention times.
- Nitrogen gas (N<sub>2</sub> – a non-regulated and benign emission) is the final product of TKN removal.
- BioFiltro has a long life, and low maintenance requirements.
- BioFiltro applies a Wastewater as a Service (WAS) financial model and charges 1.1-1.5 cent per gallon of treated wastewater.
- The removal of ammonia and Total Kjeldahl Nitrogen (TKN) from wastewater was 85% and 74%, respectively.
- BioFiltro system reduced atmospheric ammonia emission by 90.2% compared to untreated lagoon water.
- BioFiltro produces worm castings that can be sold.



#### NEWTRIENT

10255 W. Higgins Road  
Suite 900  
Rosemont, IL 60018  
1.866.123.4567  
info@newtrientllc.com

[www.newtrient.com](http://www.newtrient.com)

**RESULTS**

There is a relatively small amount of ammonia emission from the filter system top due to its volatilization during wastewater sprinkling over the filter. Negligible ammonia emission was measured from the system bottom. The emission from the top was significantly lower than what was measured from conventionally aerated wastewater. Therefore, the BioFiltro system reduced ammonia emission by 90.2% without increasing other greenhouse gases (N<sub>2</sub>O, CO<sub>2</sub>, and CH<sub>4</sub>), and ethanol. The system also reduced NH<sub>3</sub> and Total Kjeldahl nitrogen (TKN) concentrations in the. The observed reduction in TKN was due to nitrification followed by complete denitrification to nitrogen gas (N<sub>2</sub>).

**CONCLUSION**

BioFiltro is a scalable and robust technology for efficiently treating dairy wastewater once the coarse solids are removed. Compared with untreated lagoon water, BioFiltro reduces the ammonia emission from dairy wastewater by 90.2% without producing other greenhouse

gases (N<sub>2</sub>O, CO<sub>2</sub>, and CH<sub>4</sub>) and ethanol. At a hydraulic retention time of 4 hours, the removal of ammonia and total Kjeldahl Nitrogen (TKN) from wastewater was 85% and 74%, respectively. The observed reduction in total Kjeldahl nitrogen in the wastewater was due to nitrification and the subsequent complete denitrification to nitrogen gas. BioFiltro can be operated at hydraulic loading rates as small as 2.5 gallons/ft<sup>2</sup>/day. It may be a promising environmental solution for dairy wastewater management with zero waste. The main products of the BioFiltro system are clean water for manure flushing or irrigation purposes; and worm castings that can be sold. However, if the Wastewater as a Service financing option is chosen by the dairyman, then most of the proceeds of the castings will remain with the BioFiltro company. In closing, BioFiltro provides a novel business model with Wastewater as a Service in which dairies are neither required upfront capital- nor operation and maintenance costs of the system in order to effectively lower nitrogen from waste in an environmentally benign fashion.



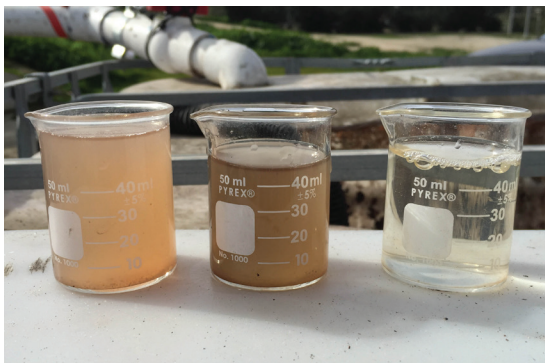
Side view of the BioFiltro system.



Top view of the BioFiltro system.



Worms in the BioFiltro system.



Water quality. From left to right: Headworks, Post Primary Filtration, and Post BioFiltro.

**Organizations Involved:**

**Farm or facility**

Fanelli Dairy

**Engineers**

BioFiltro

**Funding and Assistance:**

**Grants**

USDA-NRCS

**Equipment and Technology:**

**Manure collection**

Manure flushing system that pumped manure to uncovered anaerobic lagoon

**Preprocessing**

Lagoon storage

**Primary treatment**

Rotary screen

**Solids separation**

Screening



**NEWTRIENT**

10255 W. Higgins Road  
Suite 900  
Rosemont, IL 60018  
1.866.123.4567  
info@newtrientllc.com

[www.newtrient.com](http://www.newtrient.com)

## FANELLI DAIRY FARM PROJECT BY THE NUMBERS

<b>Location type</b>	Fanelli Dairy farm
<b>Number of animals</b>	1,300 head (treating 50%)
<b>Type of bedding</b>	Dried manure
<b>Manure collection</b>	Flush
<b>Daily flow</b>	27,000 gallons per day
<b>System designed by</b>	BioFiltro USA Inc.
<b>Energy produced/required</b>	The system requires less than a dollar a day for the quantity of wastewater treated at this installation. In addition, 4-6 hours of labor is needed per week.
<b>Products produced</b>	Worm castings that can be sold, a portion of the profits is shared with the dairy.
<b>Contracted prices</b>	1.1-1.5 cents per gallon of wastewater treated.
<b>Residual materials</b>	Treated wastewater
<b>Residual storage</b>	Effluent stored in the existing lagoon is applied to freestall lanes as flush or to fields as irrigation water.
<b>Residual use</b>	Manure flushing on dairy and cropland fertigation.
<b>Ownership structure</b>	BioFiltro applies a novel business model that is called Wastewater as a Service (WAS). In this model BioFiltro signs a contract with dairies to install and operate the system and charge 1.1-1.5 cent per gallon of treated wastewater. BioFiltro covers all repairs, replacements, and major maintenance items for the life of the contract. Moreover, BioFiltro offers the option to buy out at any time during the contract with no penalty.

## FINANCIAL INFORMATION

<b>Capital Investment</b>	If a buy option is chosen, the capital cost ranges between \$416 - \$1300 per cow and the operational cost ranges between \$33 - \$110 per cow per year.
<b>Annual operating and maintenance cost</b>	BioFiltro applies a novel business model that is called Wastewater as a Service (WAS). In this model BioFiltro signs a contract with dairies to install and operate the system and charge 1.1-1.5 cent per gallon of treated wastewater.

For more information about the BioFiltro system, or to join our mailing list, email [info@newtrientllc.com](mailto:info@newtrientllc.com).

Newtrient’s mission is to help all dairy farmers reduce the environmental footprint of manure while enhancing their economic opportunities and their social license to operate. The information contained in this case study was developed with the cooperation of the organizations involved and Newtrient has endeavoured to make sure it is accurate and complete as possible.



**NEWTRIENT**  
 10255 W. Higgins Road  
 Suite 900  
 Rosemont, IL 60018  
 1.866.123.4567  
[info@newtrientllc.com](mailto:info@newtrientllc.com)

[www.newtrient.com](http://www.newtrient.com)