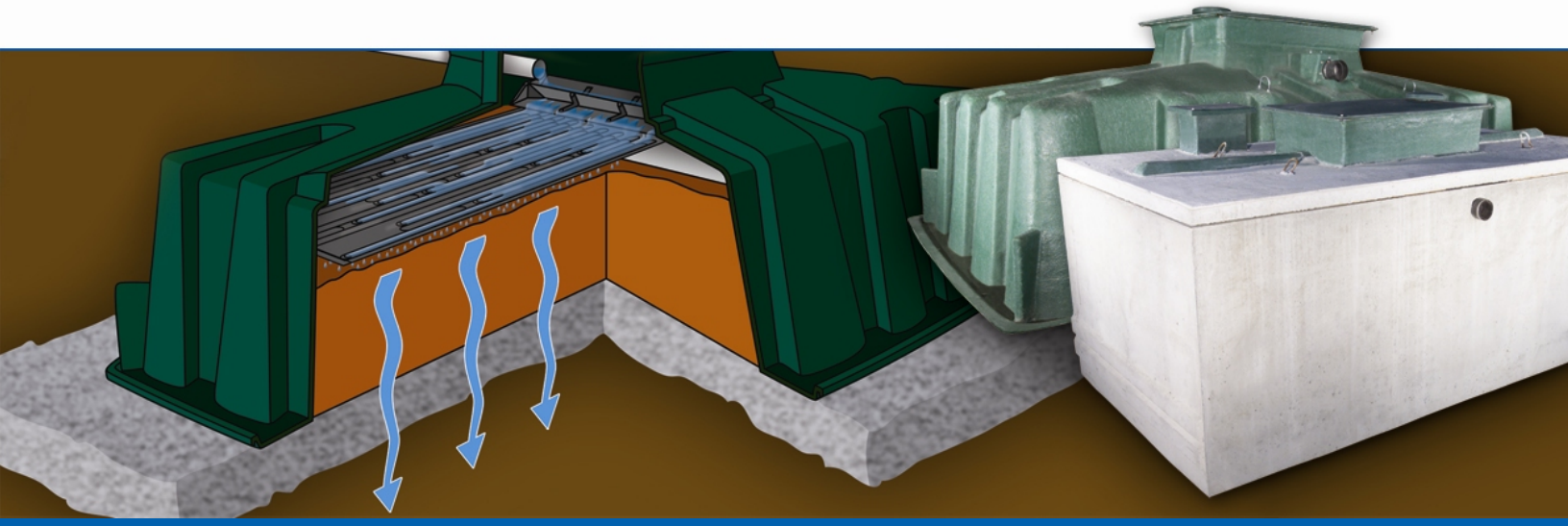

Ecoflo® Biofilter

DESIGN GUIDE - USA

April 2008

Premier Tech Environment

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1. GENERAL INFORMATION

1.1. WASTEWATER VOLUME DETERMINATION AND CHARACTERIZATION

One of the first steps in sizing a treatment chain consists in determining the volume and the characteristics of the wastewater to be treated.

1.1.1. Design Flow

The most common methods used to evaluate the amount of generated wastewater are:

- A theoretical evaluation using flow charts
- An actual flow measurement using a flow meter
- A comparison of wastewater flows in similar buildings

The engineer in charge of designing the treatment system should consider all aspects likely to impact daily flow, such as:

- Usage, as well as the current and future size of the building
- Water consumption habits
- Type and age of plumbing fixtures
- Peak flow periods and variations in flow rates
- Current and forecast activities

Each of these factors can affect daily flow and should be taken into consideration by the designer when sizing the treatment system. As well, the evaluation of the design flow must take the current and future needs of the building into account.

Flow Charts
This widely used method allows for a theoretical evaluation according to type of activity. The flow charts used must be in line with local regulations. The value of the flow determined by these charts usually corresponds to the mean daily flow required at maximum capacity. However, the factors listed above can cause this value to change.

Flow meters
Flow meters make it possible to precisely measure the water consumption of the building. Some uses of water do not necessarily release wastewater; for example, lawn watering, pool fill-up, etc. Values such as these should be removed from flow-meter readings. However, increasing the flow-meter readings by a safety factor that takes into account the future occupancy of the building, a possible change in ownership, different water consumption habits and the activities undertaken is strongly recommended.

Comparison of wastewater flow in similar buildings
This method is often used when the activities taking place in the enterprise are not found in the flow tables and the project is not yet underway. When this method is used, the engineer must consider all the factors mentioned above. As well, it is advisable to increase the resulting flow rate to account for risks and uncertainties, and a water meter should be installed once the work is completed. If necessary, a water characterization should be undertaken to validate the size of the chain of treatment.

1.1.2. Wastewater characteristics

The **Ecoflo® Biofilter** is designed to treat domestic wastewater. It can be used for commercial, institutional and community projects when the wastewater to be treated is comparable to wastewater from individual residence. When in doubt, a complete characterization of the wastewater should definitely be undertaken before choosing this type of system. **Premier Tech Environment** provides a line of products that might be better suited for loaded wastewater. Do not hesitate to consult our Technical Support Department for more information.

Table 1.1 Typical characteristics of the primary domestic effluent at the septic tank outlet

Parameter	TSS (mg/L)	$CBOD_5$ (mg/L)	Fecal coliforms (FCU/100 mL)
Mean concentrations	60 to 100	160 to 200	750,000 to 1,500,000

1.2. SITE EVALUATION

The installation of the **Ecoflo® Biofilter** is very flexible. It can be installed above or in-ground, by itself or in clusters. The clusters can be grouped together or scattered on the site. Depending on site conditions, dispersal standards and local regulations, its effluent can be infiltrated in the ground, discharged into a watercourse or directed to a tertiary treatment system.

To determine the position, shape and configuration of the components in the chain of treatment, a complete evaluation of the site must be undertaken. Regulations require the respect of certain standards concerning the receiving site, the setbacks with regards to certain benchmarks and the sizing of the components with regards to the type of soil and the type of disposal.

Soil characterization and localization of the groundwater table are essential in a wastewater treatment project. This information helps determine the size of the system, its location and the way it will be fed. Since the **Ecoflo® Biofilter** is an aerobic type of treatment system, it requires air to function properly. For projects where soil infiltration is used to dispose of the treated effluent, the rise of the groundwater table must be calculated. If the highest level of groundwater table is not properly determined and water gets into the treatment system, the performance and lifespan of the filtering media will be affected. Do not hesitate to consult our Technical Support Department for more information.

As well, measures must be taken to prevent any water external to the system from entering the infiltration zone. Precautions must be taken to ensure any external source of water is diverted away from the system.

Finally, it's important to consider that availability of materials and access to the site may affect project costs.

The sections below provide information on system sizing according to flow rates and site characteristics.

1.3. DETERMINATION OF THE EFFLUENT DISPOSAL METHOD

With the **Ecoflo® Biofilter,** various disposal methods can be used, depending on local regulations.

Here are some suggestions from **Premier Tech Environment**:

- Subsurface discharge to a disposal method, like a conventional trench, a shallow buried trench, an absorption bed, drip irrigation or any type of gravelless system
- Discharge to a tertiary treatment system
- Discharge into a watercourse if permitted by local regulations

1.3.1 Subsurface discharge

Soil characterization and seasonal high water table (SHWT) are two critical factors in designing a wastewater treatment system since they determine the type, size and location of the disposal method.

An accurate assessment of the soil's hydraulic conductivity and an SHWT evaluation are crucial steps in planning a septic system installation. Such an installation should be performed by a qualified individual, in accordance with local regulations. The soil's hydraulic conductivity is often expressed as a percolation rate, which can be determined using a field permeability test, laboratory soil analysis or any other method permitted by local regulations.

1.3.2 Discharge to a tertiary treatment system

Depending on the discharge standards set by environmental authorities regarding the vulnerability of the receiving environment, a tertiary treatment may be required. In such a case, the treated water flowing from the **Ecoflo® Biofilter** must be collected and directed toward a tertiary treatment system.

1.3.3 Discharge into a watercourse

The **Ecoflo® Biofilter** effluent may be discharged into a watercourse if this option ***is permitted by local regulations.*** The site must be graded to allow any surface runoff to flow away from the septic system.

2. TREATMENT PERFORMANCE

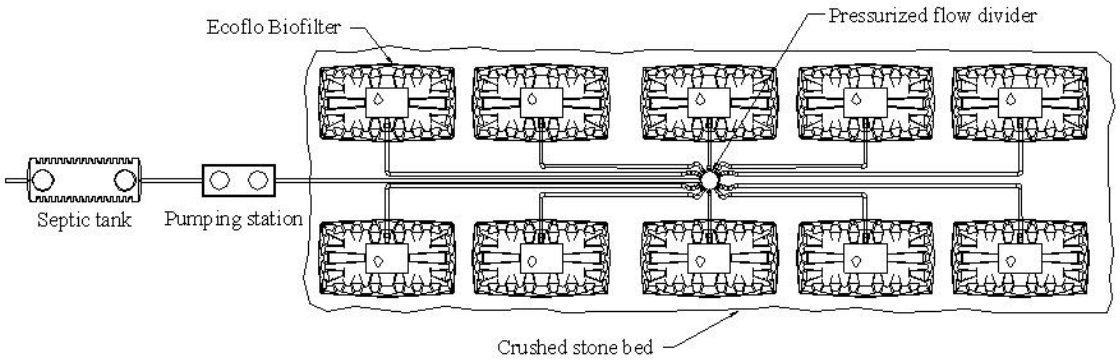
Table 2.1 Ecoflo® Biofilters treatment efficiency

Parameters	Concentration at the septic tank effluent*	Concentration at the Ecoflo® Biofilter effluent**
Organic Matter ($CBOD_5$)	≤ 200 mg/L	≤ 2 mg/L
Total Suspended Solids (TSS)	≤ 100 mg/L	≤ 2 mg/L
Fecal Coliforms (FC)	≤ 1,500,000 CFU/100 mL	≤ 948 CFU/100 mL

**Typical values according to sampling campaigns in United States and Canada since 1995 (80% of septic tank effluent samplings).*
******* *Results obtained during ANSI/NSF Standard 40 certification testing period.*

3. CLUSTERING

Clustering consists of connecting several **Ecoflo® Biofilters** in parallel on a same site. **Premier Tech Environment** provides a complete line of flow dividers to form clusters of 2 to 10 **Ecoflo® Biofilters** (see the *Peripherals* section of the Product Technical Manual for more information). Depending on the scope of the project, distributing the clusters over a few treatment sites to take advantage of the topography of the sites and reduce sewer and pumping costs may prove to be very economical. The flexibility of this **Ecoflo® Biofilter** disposal method provides an adapted solution for each site and, as a result, optimizes costs and reduces environmental impacts.



Clustering is perfectly suited to commercial, institutional and community projects. In a commercial project, when the wastewater is generated by several buildings, it would be economical to install a cluster of biofilters for each building and, as a result, reduce sewer costs. If a municipality does not have enough space to install an entire chain of treatment, it may find that clustering has many

advantages or, when a residential sector consists of small lots that make it difficult to install individual systems, clustering **Ecoflo® Biofilters** makes it possible to use one site for the treatment of the wastewater from several properties.

If more than one cluster is required for a particular site, clusters should all be of the same size. Same-size cluster allotment makes it easier to program the dosage to the biofilters. For example, a project requiring 26 biofilters on the same site should be designed with 27 biofilters, that is, 3 clusters of 9 biofilters each. If the sizing of the treatment chain already takes a safety factor into account, the number of biofilters can then be reduced. In such a case, the engineer responsible for the installation must make sure that the treatment chain sizing meets the needs of the project.

Premier Tech Environment also provides control and dosing units that can feed one or several **Ecoflo® Biofilters**. Simplex, duplex, triplex and quadruplex control panels can feed up to 4 clusters of **Ecoflo® Biofilters** from a single control unit and, if needed, can program the dosage. Dosage makes it possible to set a time-regulated pumping sequence and, as such, feed the biofilters on a regular 24-hour basis.

4. TREATMENT CHAIN SIZING

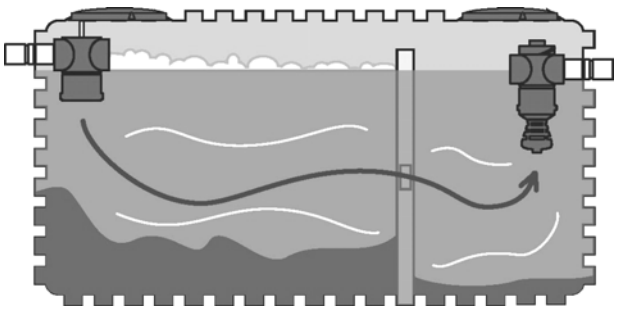
4.1. PRE-TREATMENT

Primary treatment is an essential step in treatment chain sizing. Raw wastewater contains high concentrations of solids and/or floating matter that are not easily biodegradable, such as oil and grease. If this matter reaches the treatment system, its lifespan will be greatly reduced. For decentralized wastewater treatment, the most common primary treatment systems and pre-treatment peripherals that reduce solids and floating matter are the septic tank, the effluent filter and the grease trap.

4.1.1. Septic tank

The function of the septic tank in the treatment chain is often neglected. It is important to understand that the septic tank not only holds solids, but it initiates the degradation of organic matters by making it easier to be assimilated by the micro-organisms that develop inside the secondary treatment system, like the **Ecoflo® Biofilter**. As such, the septic tank protects the treatment chain and increases its efficiency.

The capacity of the septic tank must comply with local regulations. Usually, the sizing of the septic tank depends on the maximal flow to be treated to allow a minimal retention time of 1.5 day (36 hours), including peak flows. Depending on the type of wastewater and its characteristics, applying an additional safety factor to size the septic tank is suggested. Its size cannot be increased as needed; therefore, in an effort to ensure long-term efficiency, sizing must take the potential growth of the building into account.



For community applications, individual septic tanks can be installed at each home. In such cases, the septic tank must be sized according to local regulations.

The septic tank must be watertight and sludge must be emptied regularly and in accordance with local regulation. It must be accessible at all times for inspection and pump out. **Premier Tech Environment** has developed a line of peripheral products to facilitate access to the septic tank, such as the adapter **TAD-240,** which includes an access lid and risers (**PSR-140** (14") and **PSR-60** (6")). However, note that even though the chain of treatment uses dosage and has an additional retention reservoir, the septic tank must nevertheless be sized as mentioned above.

4.1.2. Effluent Filter

The effluent filter is an essential component for commercial, institutional and community septic installations. It can be installed inside the septic tank or downstream from it, in a specific reservoir **TLF-240** from **Premier Tech Environment**. The main function of the effluent filter is to hold the negative buoyancy particles in the septic tank and prevent the release of sludge to the treatment system following re-suspension. When this method is used, the treatment system is protected against premature clogging. **Premier Tech Environment** provides a complete line of effluent filters for all applications. Do not hesitate to consult our Technical Support Department for more information.

4.1.3. Grease trap

A grease trap is required where wastewater is likely to contain hydrophobic (non-soluble) and low-density substances like oil and grease (for example, a hotel kitchen). Such matter must be removed since it can impair the components of the treatment system by causing premature clogging.

Building and septic system plumbing should be designed so that only the wastewater from those service areas likely to produce fatty or oily waste is sent to the grease trap. The grease trap outlet should direct the pre-treated wastewater to the septic tank. Obviously, regular inspections, maintenance and cleaning of the grease trap are essential to ensure optimum long-term performance. The inspection and cleaning frequency of the grease trap must be according to the flow rate and the characteristics of the wastewater generated.

The grease trap must have a retention time that allows for temperature reduction and solidification of the oil and grease. The maximal flow generated by the service areas must be used when sizing is done.

4.2. PUMPING AND DOSING

Resorting to pumping in wastewater treatment is a frequent occurrence. Generally, pumping allows the wastewater to be directed from one place to the other no matter the site topography or obstacles.

For commercial, institutional and community installations, pumps are used to distribute the wastewater flow among several **Ecoflo® Biofilters**. For residential and commercial applications with low flow rates, **Premier Tech Environment** has developed a pumping unit that provides on-demand feeding for 1 to 3 **Ecoflo® Biofilters** (see the *Dosing and Pumping* sections of the Product Technical Manual).

The most appropriate pumps are selected by taking into account the wastewater characteristics, the water volume per pumping event and the hydraulic head loss. It is normal for pumping cycles to last a minimum of 60 seconds to give the water time to cool the pumps. The number of start/stop events per hour is also an important factor to consider when selecting a pump.

The volume of the pumping station varies according to the type of operation and the number of **Ecoflo® Biofilters.** The engineer in charge must determine if the feeding method to the biofilters will be time-dependent or according to the demand. If the chain of treatment is fed using dosage, the pumping station also becomes an equalization basin and can be sized as described below. If the chain of treatment is fed without dosage, that is to say, according to the demand, the volume of the pumping station is calculated according to the number of **Ecoflo® Biofilters** to be fed. Feeding each biofilter with a maximum volume of 10 gal. per pumping event is strongly recommended.

For larger commercial, institutional or community projects, the biofilters should be fed using time dosing. Time dosing consists in setting the duration of the pumping events and the timing between two consecutive events. This feeds the **Ecoflo® Biofilters** continuously during the course of the day, which optimizes treatment efficiency. A very important advantage of time dosing is the fact that it dampens sporadic peak flows. For applications generating major variations in flow from one day to another (and even during the same day), an equalization tank can be installed downstream of the septic tank to store the overload volume of wastewater produced during peak flows. The wastewater will be held in the equalization tank and treated during non peak periods. The equalization tank can be sized to provide a hydraulic retention time between 8 (community applications) and 12 hours (commercial applications). Hydraulic retention and dosage make it possible to size the chain of treatment according to the mean daily flow calculated on a weekly basis rather than on the peak flow. This can lower the number of **Ecoflo® Biofilters** required for a project, reducing costs and making equal use of each of the biofilters. Note that the equalization tank does not replace the septic tank. When the **Ecoflo® Biofilters** are fed using dosing, special attention must be given to the usage evaluation. Again, the engineer in charge must take into account the current and future needs of the project. The volume of the dosing reservoir (equalization tank) must account for the cumulative maximal volume that will be stored over a consecutive 7-day period.

4.3. NUMBER OF ECOFLO® BIOFILTERS REQUIRED

The number of **Ecoflo® Biofilters** required (see Section 1.1) in a treatment chain is based on the daily wastewater flow that is generated.

The following table provides the flow rates to use per **Ecoflo®** module:

Table 5.1 Flow rates per Ecoflo® module

Type of application	Flow rate per Ecoflo® module (650 series)
Commercial, institutional and community	**600 gpd**

Commercial and institutional applications

Example 1
A typical office building is usually opened 5 days a week (Monday to Friday). The design daily flow (from flow charts) is evaluated at 3,000 gpd.

1) **Wastewater characteristics:**

Domestic wastewater: no on-site cafeteria and no installation likely to increase organic loadings.

Table 5.2 Domestic wastewater characteristics at the effluent of the septic tank

Parameters	TSS (mg/L)	$CBOD_5$ (mg/L)	Fecal coliforms (CFU/100 mL)
Mean concentrations	60 to 100	160 to 200	750,000 to 1,500,000

2) **Number of Ecoflo® Biofilters required:**

When a building generates variable wastewater volumes during the course of a given week, verifying whether or not dosage might reduce the size of treatment chain may be worthwhile. Sizing using time dosing is calculated by adding the flows generated during 7 consecutive days and dividing the sum by 7. This provides the mean daily flow on a weekly basis:

Mean daily Q: (3,000 gpd × 5 days) ÷ 7 days = 2,143 gpd

This mean flow is then divided by the flow rate per **Ecoflo®** module, which is 600 gpd

2,143 gpd ÷ 600 gpd = 3.6, therefore, 4 **Ecoflo® Biofilters**

3) Equalization tank volume

The volume of the equalization tank is calculated by adding the cumulative overages (see the table below) to the volume that corresponds to a hydraulic retention of 12 hours at maximal design flow (commercial application):

3,000 gpd + (3,000 gpd x 12 hours/24 hours/d) = 4,500 gpd

Table 5.3 Equalization tank volume

Day	Daily flow (gpd)	Treated flow (gpd)	Difference (gpd)	Cumulative Overage (gal.)
Monday	3,000	2,400*	600	600
Tuesday	3,000	2,400*	600	1,200
Wednesday	3,000	2,400*	600	1,800
Thursday	3,000	2,400*	600	2,400
Friday	3,000	2,400*	600	**3,000**
Saturday	0	2,400*	-2,400	600
Sunday	0	2,400*	-2,400	0

* 4 **Ecoflo® Biofilter** × 600 gpd = 2,400 gpd

This tank can then add up the daily peak flows and treat them on days when there is less demand.

Do not hesitate to consult our Technical Support Department for more information.

Community application

Example 2
Wastewater treatment of a new subdivision. The design daily flow is evaluated at 7,000 gpd.

1) **Wastewater characteristics:**

Domestic wastewater:

Table 5.4 Domestic wastewater characteristics at the effluent of the septic tank

Parameters	TSS (mg/L)	$CBOD_5$ (mg/L)	Fecal coliforms (CFU/100 mL)
Mean concentrations	60 to 100	160 to 200	750,000 to 1,500,000

2) **Number of Ecoflo® Biofilters required:**

The design flow is divided by the flow rate per **Ecoflo®** module, which is 600 gpd

7,000 gpd ÷ 600 gpd = 11.7 therefore 12 **Ecoflo® Biofilters,** divided into 2 clusters of 6 biofilters each.

3) **Equalization tank volume**

The volume of the equalization tank must provide a minimal hydraulic retention time of 8 hours (community applications) at the design flow[1]:

7,000 gpd × (8 hours ÷ 24 hours) = 2,335 gpd

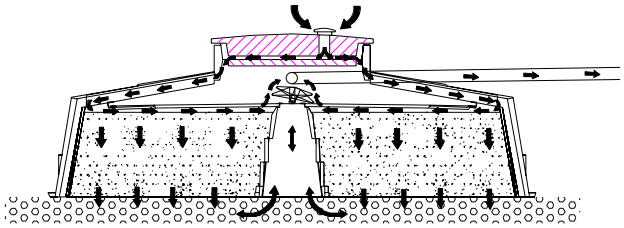
This tank can then add up the daily peak flows and provide a regular and uniform supply to the **Ecoflo® Biofilters** throughout the day.

[1] *Refer to your local regulations.*

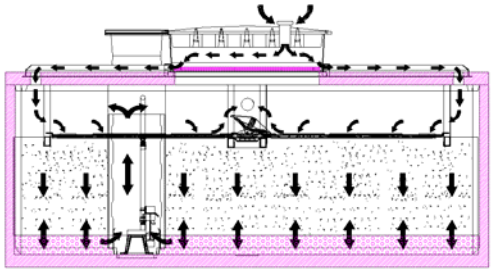
5. VENTILATION OF THE ECOFLO® BIOFILTERS

5.1 GENERAL INFORMATION

The **Ecoflo® Biofilters,** like most biological wastewater treatment systems, promote the growth of micro-organisms in aerobic conditions. These micro-organisms need oxygen to oxidize organic matter. When the quantity of oxygen inside the filtering media is not sufficient, anaerobic conditions can take place, resulting in decreased performance and the possibility of odours being released. If the biofilter is not properly positioned, this usually happens in the spring since rises in the groundwater table are at their highest in spring. If the crushed stone layer at the base of the system is submerged, filtering media oxygenation will not take place, which is why one of the requirements for sizing a treatment system with an infiltration zone in the soil is planning for the infiltration zone to always be higher than the highest level of the groundwater table.



Fiberglass model



Concrete model

The shell of the **Ecoflo® Biofilter,** either the fiberglass or the concrete model, is specially designed to facilitate air circulation inside the filtering media. An air intake is located on the access lid and a double skin brings air to the base of the biofilter. The oxygen content in the air is used to oxide the polluting organic matter and to nitrify the nitrogen species.

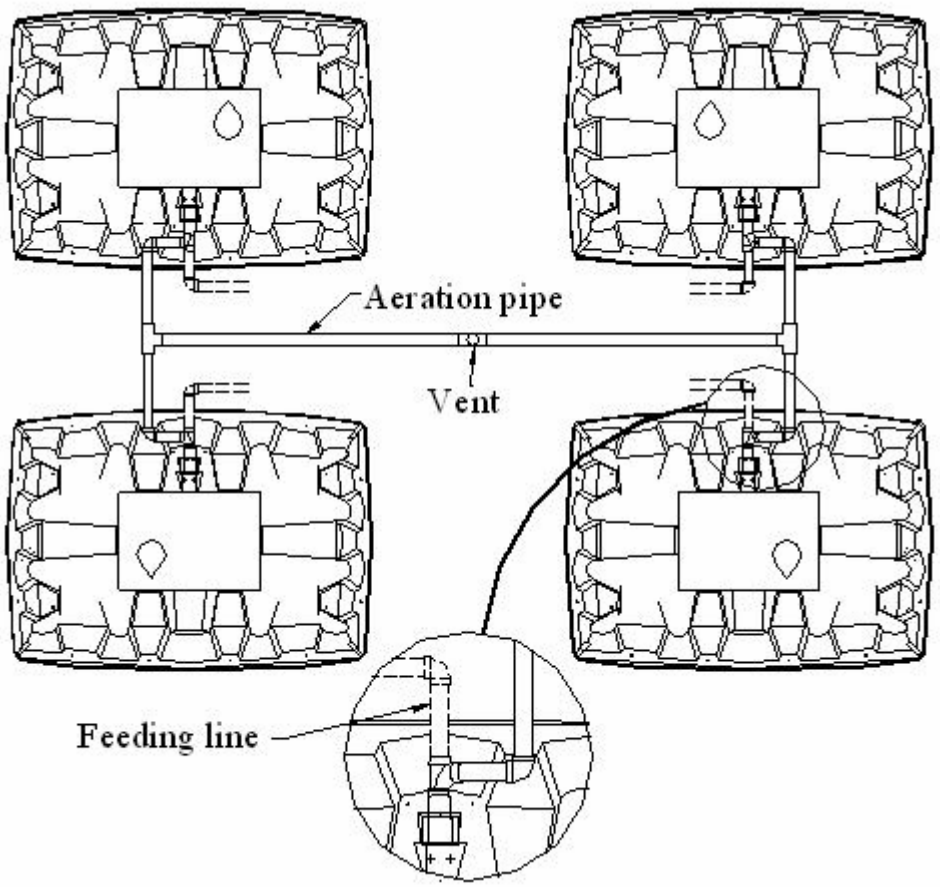
In short, good ventilation is necessary for aerobic systems to operate properly. Aeration of the **Ecoflo® Biofilter** can be passive or forced, depending on site conditions and the size of the treatment chain.

5.2 PASSIVE VENTILATION

Passive ventilation consists of creating a chimney effect to force air through an air intake at the bottom of the biofilter and suck it up to be released through an opening that is exposed to prevailing winds. A regular building vent is sufficient for gravity systems with 4 or fewer **Ecoflo® Biofilters**. In such cases, foul air is carried through the sewage pipe and the septic tank, then up the ventilating duct and released. To be effective, air must move freely through the ventilating duct. For **Ecoflo® Biofilter** installations fed by pumps, free air circulation between the pumping station and the biofilters is not possible. In such cases, an air-circulating pipe must be installed between the biofilters and the pumping station.

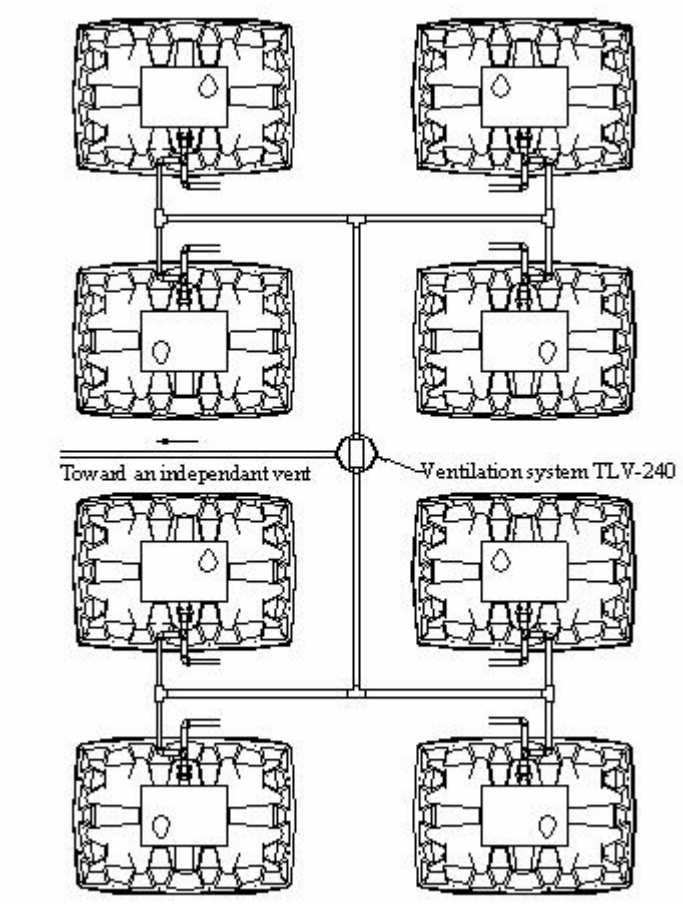
Independent vents are required for installations with more than 4 **Ecoflo® Biofilters**. Connecting an even number of **Ecoflo® Biofilters** (up to 4) is recommended.

PVC pipes no smaller than 4" in diameter can be used for passive ventilation systems. The **Ecoflo® Biofilters** must be interconnected, if possible, in a symmetric pattern to ensure that air flows evenly between the units. The independent vent must be high enough to release the air and should end in a gooseneck equipped with an insect screen. The vent is connected on the feeding line attached to the inlet of the **Ecoflo® Biofilter.**



5.3 FORCED VENTILATION

For projects where several **Ecoflo® Biofilters** must be installed or when it is not possible to connect 4 biofilters to the same vent (for feasibility, ventilation or aesthetic reasons), forced ventilation can be used. With forced ventilation, the biofilters can be connected in clusters of up to 10 units. The ventilating ducts running between the **Ecoflo® Biofilters** must be no smaller than 4″ in diameter. As well, the main ducts downstream of the **Ventilation system TLV-240** and the independent vents must be no smaller than 6” in diameter.



Please consult the **Premier Tech Environment** Technical Support Department for more details on **Ecoflo® Biofilter** ventilation and vent configuration.

6. SYSTEM MAINTENANCE AND ENVIRONMENTAL FOLLOW-UP

6.1 PREVENTIVE MAINTENANCE

Like most wastewater treatment systems, annual maintenance of the **Ecoflo® Biofilter** is essential for it to function properly. During this annual maintenance visit, all system components are inspected thoroughly to make sure they are functioning properly and the surface of the filtering media is raked to promote maximum oxygenation and eliminate build-up.

The expected life of the filtering media is eight (8) years. However, it is depending on usage and compliance to the guidelines in the *Operation and Maintenance Manual* that is provided to the owner once the system has been installed. Excessive or improper use, for example, putting toxic substances in the sewage treatment system, excessive water consumption and poor septic tank maintenance, will reduce the efficiency of any septic installation, including the **Ecoflo® Biofilter**. This can even result in the filtering media having to be replaced earlier than it should. Note that **Premier Tech Environment** warrants the performance and life of the filtering media for commercial and community for a period of two (2) years when sizing is done according to this Design Guide, and the manufacturer's recommendations are complied with. Please refer to the *Operation and Maintenance Manual* for more details.

Proper system maintenance helps maximize the life and performance of the **Ecoflo® Biofilter**. It also gives the owner peace of mind knowing that his/her septic system is operating properly.

6.2 ENVIRONMENTAL FOLLOW-UP

For commercial, institutional and community projects, local authorities may require an environmental follow-up when the certificate of authorization is delivered. Please refer to your local regulations for more information.

Premier Tech Environment *can have its technical services staff perform this follow-up program, and on request, will provide a very competitive quote showing all costs related to the visits and/or samplings required.*

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