Orenco WATER *Design Aid*

Biotube® Effluent Filter Sizing

Introduction

This design aid will help calculate the correct sizing and cleaning frequencies for effluent filters in most, but not all, wastewater filtration situations.*

Considerations

Watertight Septic Tanks

Completely watertight septic tanks allow accurate determination of effluent filter sizing. Without a watertight tank, it is impossible to accurately size the tank's effluent filter.

Tankage and Hydraulic Retention Time

Adequately sized septic tankage digests organic material, removes settleable and floatable solids, helps modulate flow, and discharges effluent that consistently meets "primary treatment" standards. Inadequate tankage results in poor effluent quality and shorter pumping intervals.

Septic tank capacities for single-family residences – At least 1000gal (3785L) capacity is needed to handle flows from a residence with up to 3 bedrooms. At least 1500gal (5678L) capacity is needed for flows from a residence with 3 or more bedrooms, up to flows of 600gpd (2270L/day), or from a residence with up to 3 bedrooms using a kitchen garbage disposal.

Septic tank capacities for larger flows – A capacity of two to four times the daily design flow is needed for flows greater than 600gpd (2270L/day).

For recommendations on tank sizing for applications larger than single-family residences, see NDA-ATX-1, *Design Criteria: Commercial Treatment Systems*, Appendix A; and NTP-TNK-TRB-2, *Septic Tank Sizes for Large Flows*.

Waste Strength

These guidelines assume wastewater that is primary-treated and residential-strength, equivalent to what Crites and Tchobanoglous describe as "expected effluent wastewater characteristics from a residential septic tank without ... effluent filter" (*Small and Decentralized Wastewater Management Systems*, Table 4-16, p. 183).

These characteristics are listed below.

BOD_5	= 180mg/L
TSS	= 80mg/L
Oil & grease	= 25mg/L

Filter Surface Area vs. Flow Area

Compare both the total surface area and the total flow area of the filter. Flow area is as critical as filter surface area. The surface area of a filter is where solids are caught. The flow area (the "holes" in the filter) is what prevents premature clogging.

Filter Housing Height

Select the height of the filter housing for the correct fit on the inside of the tank. The correct height positions the housing's inlet holes at 60-80% of the normal liquid level in the tank, which corresponds to the tank's invert of outlet elevation.

Modulating Peak Flows

Effluent filters must be able to handle situations in which most of the daily flow enters the septic tank over a short period of time. Modulating plates with orifices can limit the flow rate through a tank during peak flow, to prevent the flushing out of solids, but only if the tank has sufficient surge capacity. Simple high-liquid-level alarms can be added to any Orenco effluent filter.

Filter Sizing Equations

$$A_F = C_f\,(Q)\,(MTBC)$$

where: A_F = Filter area required (ft^2 or m^2)

C_f = Filter coefficient $\left(\frac{ft^2}{Q \bullet yr}\right)$ or $\left(\frac{m^2}{Q \bullet yr}\right)$

Q = Daily flow (gpd or m^3/day)

MTBC = Mean time between filter cleaning (in years)

Actual (true) daily flow rates use a filter coefficient of 0.0044 (US units) or 0.018 (SI units). Daily design flow rates use a filter coefficient value of 0.002 (US units) or 0.05 (SI units). Design flow is defined as a peak flow that allows for a safety margin. It is typically about twice the actual flow. All values assume a filter surface area with approximately 30% or more open or "flow" area.

Actual Flow Equations

US units: $A_F = 0.0044\,(Q)(MTBC)$
SI units: $A_F = 0.018\,(Q)(MTBC)$

Design Flow Equations

US units: $A_F = 0.002\,(Q)(MTBC)$
SI units: $A_F = 0.05\,(Q)(MTBC)$

These equations are valid for single-family and larger systems with residential-strength wastewater and properly sized tankage.

Kitchen garbage disposals increase solids loading to a system by about 36%. Increasing the effluent filter area by 36% gives better approximations for sizing and cleaning frequencies for systems with kitchen garbage disposals. For a single-family residence with a kitchen garbage disposal, more frequent effluent filter maintenance may be necessary.

** Orenco's effluent filter performance data is so extensive that Dr. George Tchobanoglous, co-author of* Small and Decentralized Wastewater Management Systems, *used that data to help develop his findings on effluent filters.*

Design Flow Equations, cont.

Systems with capacities of less than three times the daily design flow require more conservative filter sizing to prevent the need for frequent cleaning. Systems with higher than residential-strength wastewater require detailed analysis of their wastewater characteristics for proper tank and filter sizing and configurations. Multiple filters may be required. Please contact Orenco to discuss these applications.

Selecting a Biotube Effluent Filter

Table 1. Filter and Flow Area Chart

Series	Filter area, ft² (m²)	Flow area, ft² (m²)
FT15-36	50.5 (4.7)	15.2 (1.4)
FT12-36	30.0 (2.8)	9.0 (0.8)
FT08-36	14.6 (1.4)	4.4 (0.4)
FT04-36	5.1 (0.5)	1.5 (0.1)
PSCS0621-18	6.3 (0.6)	1.9 (0.2)

Design Example

A 12-unit condominium complex has a design flow of 3600gpd (13.63m³/day) or 12 units at 300gpd (1135L/day) per unit. If a minimum 3-year cleaning frequency is desired, how much filter area is necessary? Which Biotube Effluent Filter should be selected?

In this case, the equation for design flow is applicable:

$A_F = (0.002 \times 3600 \times 3) = 21.6ft^2$
or
$A_F = (0.05 \times 13.63 \times 3) = 2.04m^2$

Referring to Table 1, an FT12-36 filter, with a filter area of 30.0ft² or 2.8m², is required to satisfy the minimum design criteria.

Using the 30ft² or 2.8m² filter area, the design flow equation can be solved for MTBC, giving a cleaning frequency of roughly four years.

MTBC = 30.0 / (3600 × 0.002) = 4.2 years
or
MTBC = 2.8 / (13.63 × 0.05) = 4.1 years

If the units will include kitchen garbage disposals, the filter area is increased by 36% to account for additional solids loading:

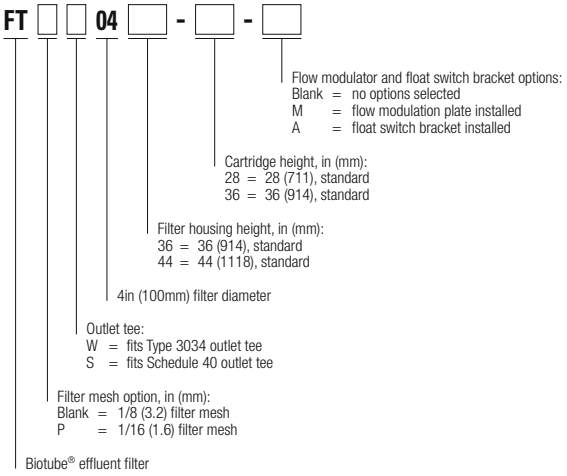
$A_F = (1.36 \times 21.6) = 29.4ft^2$
or
$A_F = (1.36 \times 2.04) = 2.8m^2$

And the MTBC is reduced to ...

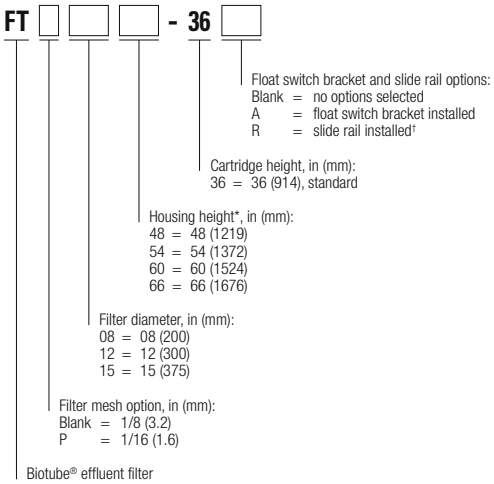
MTBC = 30.0 / (3600 × 0.002 × 1.36) = 3.1 years
or
MTBC = 2.8 / (13.63 × 0.05 × 1.36) = 3.0 years

Product Code Diagrams

Standard Residential Filters



Standard Commercial Filters



* Minimum liquid level (MLL) information:
48in (1219) housing for MLL of 37-46in (940-1168mm)
54in (1372) housing for MLL of 47-63in (1194-1600mm)
60in (1524) housing for MLL of 64-84in (1626-2134mm)
66in (1676) housing for MLL of 85-112in (2159-2845mm)

† For 12in and 15in (300mm and 375mm) only; use slide rail option when there is only one access point to the filter chamber

PSC Series Filters