

AdvanTex® Design Criteria

For Single-Family Home Applications — AX15-RT3 Treatment System

System Description and Treatment Process

The AdvanTex® Treatment System is a multiple-pass, packed-bed aerobic wastewater treatment system specifically designed and engineered for long-term processing of residential strength wastewater. The treatment media is an engineered textile, which has an extremely high void capacity, moisture-holding capacity, and surface area per unit volume. Consequently, AdvanTex Treatment Systems are capable of processing residential strength wastewater to better than “secondary standards.”

The AX15-RT3 uses the same recirculating textile filter technology as Orenco's other textile filters, but combines the textile filter media, primary tank, recirculation tank and discharge tank into a single, shallowly buried unit.

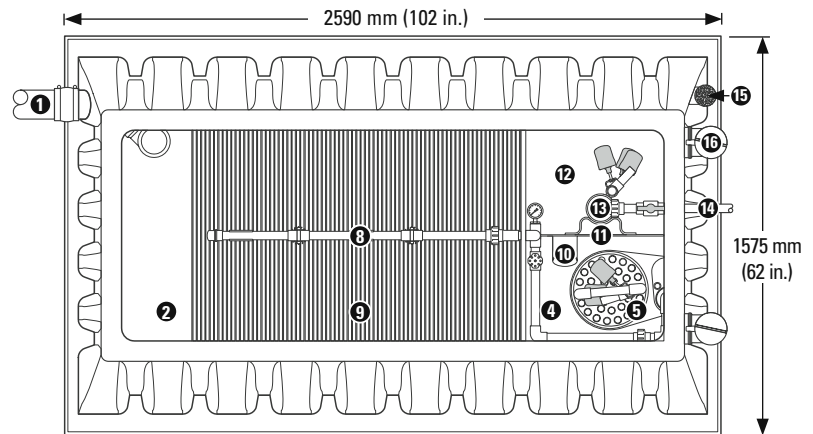
Here's how it works: raw sewage enters the primary chamber through the inlet tee. In the primary chamber, the raw sewage separates into three distinct zones — a scum layer, a sludge layer, and a clear layer. Effluent from the clear layer passes through ports in the primary baffle to the recirculation chamber, which contains a Biotube® Pump Package.

The recirculation pump is timer controlled to ensure that small, intermittent doses (micro-doses) of effluent are applied to the textile sheets throughout the day. This ensures an aerobic, unsaturated environment for optimal treatment to occur. A manifold with spray nozzles rests on top of the textile sheets and distributes the effluent evenly over the sheets. The effluent then percolates down through the textile sheets and is distributed between the primary, recirculation and discharge chambers by means of the primary baffle and recirc-discharge baffle.

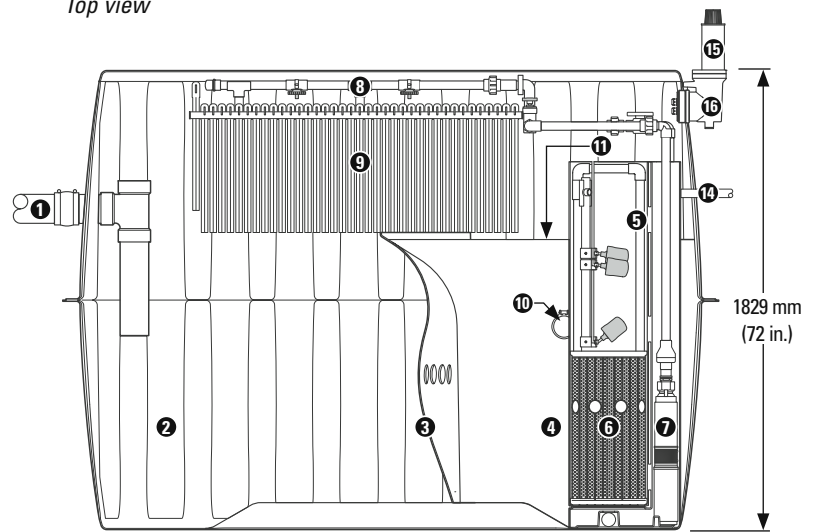
The textile material is suspended from the top of the treatment unit. 50% of the media is suspended over the primary chamber, 25% is suspended over the recirculation chamber, and 25% is suspended over the discharge chamber. The recirculation chamber is separated from the discharge chamber by the recirc-discharge baffle.

The recirc-discharge baffle is fitted with a swing-check valve for equalizing the volume of treated effluent between chambers during low daily flow conditions. Under low daily flow conditions, the swing-check valve allows 100% of the final filtrate to be returned to the recirculation chamber for continued recirculation. The swing-check valve is similar to a check valve in that it allows preferential flow in one direction only, in this case, from the discharge chamber to the recirculation chamber. The swing-check valve closes when the liquid head on the recirculation side is equal to or greater than the liquid head on the discharge side. When the liquid head on the discharge side is higher, the pressure differential pushes the swing-check valve open for filtrate to pass back to the recirculation side of the baffle, thus providing for continued recirculation during periods of low or no inflow. Flow from the recirculation chamber can pass to the discharge chamber only through the treatment media.

Figure 1. AdvanTex AX15-RT3 Treatment System



Top view



Side view

Components

- | | | |
|-----------------------------|-----------------------------|---------------------------------|
| ① Inlet | ⑦ Pump | ⑬ Flow inducer and pump |
| ② Primary chamber | ⑧ Manifold and spin nozzles | ⑭ Final discharge |
| ③ Primary baffle | ⑨ Textile media | ⑮ Passive air vent |
| ④ Recirculation chamber | ⑩ Swing-check valve | ⑯ External splice box |
| ⑤ Biotube® pump vault | ⑪ Recirc-discharge baffle | ⑰ MVP control panel (not shown) |
| ⑥ Biotube® filter cartridge | ⑫ Discharge chamber | |

AX15-RT3 Residential Design Criteria (cont.)

System Requirements: Residential Strength Wastewater

Residential wastewater must meet the criteria below in Table 1. Consult Orenco or your AdvanTex Dealer for larger system designs. Water softener backwash from a salt-type water softener must not be plumbed into the AX15-RT3, as this will void the system's warranty. See the Orenco white paper, *Water Softeners and Wastewater Treatment Systems*, AWP-SOFT-1, for more information.

Table 1. Residential Strength Wastewater (Influent Characteristics)¹

Characteristic	Average (mg/L)	Weekly Peak (mg/L)	Rarely Exceed (mg/L)
CBOD ₅	130	200	300
TSS	40	60	150
TKN	65	75	150
G&O	20	25	25

¹ Maximum allowable wastewater strength pumped to an AdvanTex Treatment System is "Residential Strength Wastewater." Residential strength wastewater is defined as primary sewage effluent that does not exceed the above parameters.

Design Loading Rates

Orenco's suggested design loading rates are based upon typical per capita flow rates (170-227 L/day/person or 45-60 gpd/person) and average strength characteristics as shown in Table 1. Performance is a function of the expected typical loads with periodic weekly highs. Typically, the daily mass loading is based on the expected daily flows and actual strength.

Orenco's AX15-RT3 is suitable for residences with a maximum design flow of 1080 L/day (285 gpd). For applications with flows that exceed 1080 L/day (285 gpd), Orenco's AdvanTex AX20 product line is necessary.

Typical Effluent Quality

Effluent quality is dependent on a number of factors, including influent characteristics and loading rates. Low-to-moderate loading rates typically produce cBOD and TSS of <10 mg/L, while higher loading rates produce cBOD and TSS in the range of 15-25 mg/L. Field testing of systems in real-world conditions shows similar results.

Nitrogen reduction will typically exceed 60 percent, with total nitrogen in the filtrate ranging between 25-35 mg/L, depending on wastewater strength and other characteristics like grease and oils, pH, and alkalinity concentrations. Nitrification can be inhibited if the buffering capacity (alkalinity) of the wastewater is too low. On a theoretical basis, 7.14 mg/L of alkalinity as CaCO₃ is needed to nitrify 1 mg/L of NH₄⁺.

Pumping Equipment: Recirc Pump

The integrated treatment package includes an Orenco Biotube® pump package.

Residual Head Pressures

A 24 kPa (3.5 psi) manifold pressure is used to determine the initial timed-dosing settings. Consult Orenco if the manifold pressure falls outside the typical 20.7-24.0 kPa (3.0-3.5 psi) range.

Recirculation Ratios and Timer Settings

The initial timer settings for the AX15-RT3 should be established based upon expected average daily flows and a recirculation ratio of 4:1 (filter recirculation ratio). If flows vary significantly from expected flows, timer settings should be adjusted accordingly. Contact Innoflow or Orenco for more information.

AdvanTex Control System

Critical to the success of the AdvanTex Treatment System is the method in which the effluent is loaded onto the textile sheets. Over the past three decades, timer-controlled applications have played an essential role in optimizing the performance of both fixed and suspended-growth biological systems. A timer controlled pump in the treatment tank periodically doses effluent to the distribution manifold over the textile sheets. The effluent then percolates through the textile media and is treated by naturally occurring microorganisms that populate the filter. During periods of high flow, a timer override float will temporarily modify the timer settings to process the additional flow. Conversely, during periods of low flow, the timer settings can be modified to reduce loading onto the filter.

Surge Volume/ Emergency Reserve Volume

The AX15-RT3 has approximately 570 liters (150 gal.) of surge volume between the primary, recirculation, and discharge chambers — or about one half-day of the design's nominal daily flow — before the override function is activated. The override surge volume provides an additional 530 liters (140 gallons) of surge volume before the high-level function is engaged at approximately 50 mm below the top of the baffles. In addition to the surge volume, the AX15-RT3 has an additional 2300 liters (600 gallons) of emergency capacity, measured from the top of the baffle walls to the inside top of the unit. After an event occurs that requires using the emergency capacity, the textile sheets should be cleaned thoroughly. Additionally, each of the chambers should be measured afterwards for solids deposits and pumped as needed.

Most rural homes outfitted with low-flow fixtures and limited water supply produce about 560 liters (150 gallons) of wastewater per day, as a conservative estimate of use by 3-4 occupants. Power outages occur infrequently and typically last from a few hours to 1-2 days. Downtime associated with mechanical malfunctions is limited due to the robustness of the mechanical components of the AX15-RT3. Replacement components are readily available and the system can usually be returned to normal operation within hours or a day at most. The AX15-RT3 is designed with sufficient emergency capacity to handle both situations.

Mechanical malfunction — The AX15-RT3 has approximately 3 days worth of surge and emergency capacity. Failure of a pump or electrical component will trigger an alarm alerting the homeowner to the failure. The amount of the system's capacity used during a mechanical malfunction is dependent on the homeowner calling the Service Provider promptly after the alarm condition begins and the timely response of the Service Provider.

Power outage — During a power outage, water usage is significantly reduced because well pumps, water heaters, dishwashers, and laundry equipment aren't used. Under these conditions, it is realistic to estimate that water usage will be reduced by 50-70 percent and the emergency storage capacity available in the system will increase substantially. Since power outages typically last less than 2 days, the emergency storage capacity of the system is more than adequate.

Discharge Equipment

The integrated treatment package includes an Orenco flow inducer and 100-mm (4-in.) submersible effluent pump, incorporated into the discharge chamber of the AX15-RT3 unit.

For areas that require disinfection before dispersal, a UV unit can be installed in a pump basin that houses both a UV unit and discharge pump.

Cold Weather Considerations

The AX15-RT3 unit can be ordered with 25-mm (1-in.) of insulation attached to the bottom of the lid. Installing insulation around the sides of the filter pod is optional and is done on-site as needed. Other cold weather considerations include allowing all lines to drain between doses, backfilling the risers with pea gravel if frost heave is a concern, and extending the passive vent filter above the highest level of snow pack during winter months to ensure adequate airflow. Consult Innoflow or Orenco if supplementary options need to be considered.