

AdvanTex® Performance Summary #2

Nutrient Reduction: TN, NH₃, TP

AdvanTex® Treatment Systems — Manufactured by Orenco Systems®, Inc.

Since 2001, the performance of AdvanTex® Treatment Systems has been tested in a dozen different programs. Tests have been performed both in test centers and in the field. These include testing performed by outside companies or agencies (third-party); contract testing performed by Orenco distributors (second-party); and Orenco's own testing (first-party). More than 1000 data points have been collected.

This performance summary documents the performance of AdvanTex Treatment Systems relative to nutrient reduction . . . specifically, reductions in Total Nitrogen (TN), Ammonia (NH₃), and Total Phosphorous (TP). The results show that AdvanTex systems easily meet advanced treatment standards for nitrogen and total phosphorous.

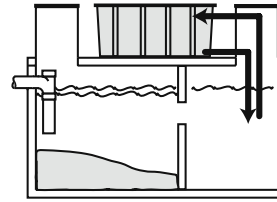
About System Configurations

As shown in the illustrations on the right, AdvanTex systems can be configured in several ways depending on the degree of total nitrogen reduction required. In Mode 1, filtrate from the AdvanTex pod is recirculated to the secondary chamber of the septic tank. In Mode 3, the filtrate is recirculated to the primary chamber, where the environment favors further denitrification. In Combo mode, the filtrate is recirculated to both chambers, in controlled proportions.

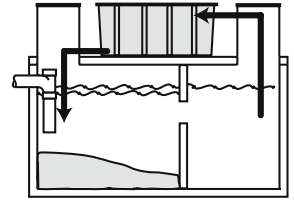
In Virginia, North Carolina, and Rhode Island, some of the systems tested in Mode 1 incorporated two tanks: a primary tank and a recirculation tank. In the primary tank, sludge and scum are separated from liquid effluent, which then flows into a separate recirculation tank, into which the AdvanTex filtrate is recirculated.

About the Results

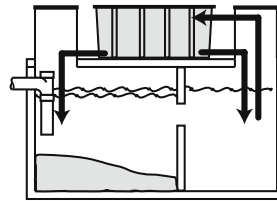
The table below summarizes effluent testing results for Total Nitrogen, Ammonia, and Total Phosphorous, both from test center programs and field testing programs. The pages that follow provide more specific results of these testing programs. For ease of comparison, we have also included information about the circumstances of each test. If you have any questions regarding this summary, please contact Sam Carter, Government Relations Manager, Orenco Systems, Inc., (800) 536-4192, scarter@orencos.com.



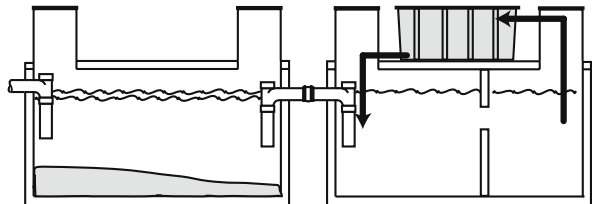
Mode 1 with processing tank



Mode 3 with processing tank
(Optimized for denitrification)



Combo Mode with processing tank



Mode 1 with primary tank and recirculation tank

TEST CENTERS SUMMARY

AdvanTex Effluent Averages	Total N (mg/L)^a	NH₃ (mg/L)	Total P (mg/L)	Duration
NSF/ANSI Standard 40 Testing	12 (64%) ^b	0.9 (96%)	-	7 months
NSF/ANSI Standard 40 Testing with UV Disinfection	13 (66%)	1.1	-	6 months
Rotorua District Council Approval Testing	13 (82%)	0.2 (99%)	8 (33%)	13 months
New Zealand OSET Testing Programme	12 (80%)	0.6 (99%)	-	10 months

FIELD TESTING SUMMARY

AdvanTex Effluent Averages (# of SFRs)^c	Total N (mg/L)	NH₃ (mg/L)	Total P (mg/L)	Duration
Roger Shafer, P.E., "Testing in Fractured Bedrock" (1)	14 (63%)	-	6 (33%)	8 months
NSF Pennsylvania Testing Program (11)	17 (68%)	1.7 (96%)	-	1-3 years
Virginia Approval Testing Program (13)	15	1.8	-	18 months
Jefferson County Health Dept. Permit Testing (43)	15	-	-	2 years, 7 months
Skaneateles Demonstration Project (2)	14	0.9	10	2 years, 2 months
La Pine National Demonstration Project (3)	17 (74%)	1.9	9 (18%)	2 years, 7 months
Rhode Island Demonstration Project (5)	18	-	9	1 year, 4 months
North Carolina Approval Testing Program— Mode 1 (14) ^d	26 (63%)	-	-	2 years, 10 months
North Carolina Approval Testing Program — Mode 3 (1)	15	-	-	2 years, 10 months
Maryland Best Available Technology Field Verification (12) ^e	18 (68%)	-	-	1 year
Maryland Best Available Technology Field Verification (12) ^f	15 (82%)	1.4	-	1 year

^a TN = TKN + NO₃-N + NO₂-N

^c SFR = Single-family residences

^e AdvanTex AX20

^b Percent Reduction

^d Includes single-family residences and vacation rentals

^f AdvanTex AX20-RT

TEST CENTERS

NSF/ANSI Standard 40 Testing

(Third-Party)

About the Testing: Orenco contracted with Novatec to test an AX20 Mode 1 system in support of its application for NSF approval. Novatec conducts official NSF/ANSI Standard 40 testing under contract to manufacturers at its facility in Squamish, British Columbia. Although the NSF/ANSI Standard 40 protocol does not require it, Orenco elected to sample for total nitrogen.

Testing is done at a wastewater facility that serves a residential subdivision. Composite sampling was used throughout this evaluation.

Dates: August 2001-February 2002*

Location: British Columbia

Average Daily Flow: 500 gpd

System Configuration: AX20 Mode 1 recirculating into the second compartment of a 1500-gallon tank

*Note: Nitrogen results are from July to February, which allows for a two-month start-up period.

Processing Tank Influent

	Total N (mg/L)	NH₃ (mg/L)
Mean	34	22
Median	33	23
Number of Samples	21	21

AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)
Mean	12	0.9
Median	13	0.6
Number of Samples	27	19
Percent Reduction	64%	96%

NSF/ANSI Standard 40 Testing with UV Disinfection

(Third-Party)

About the Testing: Orenco contracted with Novatec to test an AX20N Mode 1 system with UV disinfection to determine its capabilities for reducing fecal coliform. Novatec conducts official NSF/ANSI Standard 40 testing under contract to manufacturers at its facility in Squamish, British Columbia. Although the NSF/ANSI Standard 40 protocol does not require it, Orenco elected to sample for total nitrogen.

Testing is done at a wastewater facility that serves a residential subdivision. Composite sampling was used throughout this evaluation.

Dates: July 2006-December 2006

Location: British Columbia

Average Daily Flow: 500 gpd

System Configuration: AX20 Mode 1 recirculating into the second compartment of a 1500-gallon tank with UV disinfection

Note: See *AdvanTex Performance Summary — General Reduction (AHO-ATX-PERF-1)* for fecal coliform results.

Processing Tank Influent

	TKN (mg/L)
Mean	38
Median	40
Number of Samples	22

AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)
Mean	13	1.1
Median	12	0.6
Number of Samples	20	22
Percent Reduction	66%	-

Rotorua District Council Approval Testing

(Third-Party)

About the Testing: Testing of residential wastewater treatment systems was initiated by the Rotorua District Council and Environment Bay of Plenty, the Regional Council. The purpose was to preapprove manufacturers that meet the councils' specifications. The primary focus of the 13-month trial was nitrogen reduction.

Dates: May 2005-June 2006*

Location: New Zealand

Average Daily Flow: 265 gpd

System Configuration: AX20 Mode 3

* Note: Nitrogen results are from September to June, which allows for a four-month start-up period (starting in winter).

Processing Tank Influent

	Total N (mg/L)	NH₃ (mg/L)	Total P (mg/L)
Mean	72	49	12
Median	71	49	12
Number of Samples	-	-	-

AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)	Total P (mg/L)
Mean	13	0.2	8
Median	13	0.2	8
Number of Samples	41	-	-
Percent Reduction	82%	99%	33%

New Zealand On-Site Effluent Treatment National Testing Program

(Third-Party)

About the Testing: In 2009, New Zealand released a national standard and testing protocol for on-site effluent treatment. Tests of AdvanTex AX20 systems were carried out at the Rotorua Testing Facility, and measured BOD₅, TSS, and Total Nitrogen reduction, as well as electrical power consumption.

Dates: November 2009-August 2010

Location: New Zealand

Average Daily Flow: 287 gpd

System Configuration: AX20 Mode 3

Processing Tank Influent

	Total N (mg/L)	NH₃ (mg/L)	Total P (mg/L)
Mean	60	41	-
Median	60	43	-
Number of Samples	46	46	-

AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)	Total P (mg/L)
Mean	13	0.6	-
Median	12	1	-
Number of Samples	43	43	-
Percent Reduction	80%	96%	-

FIELD TESTING

**Roger Shafer, P.E.,
Testing in Fractured Bedrock***

(Second-Party)

About the Testing: The test involved one AdvanTex system at a single-family home.

Dates: Summer 2001, Winter 2002, Winter 2007/2008

Location: Colorado

Average Daily Flow: 209 gpd (April 2001 and August 2001)

System Configuration: This system consisted of two AX10s (which together have the same treatment capacity as an AX20), configured in Mode 3, recirculating to the primary compartment of a 1500-gallon processing tank

Septic Tank Effluent**

	Total N (mg/L)	Total P (mg/L)
Mean	38	9
Number of Samples	5	5

AdvanTex Effluent

	Total N (mg/L)	Total P (mg/L)
Mean	14	6
Number of Samples	13	13
Percent Reduction	63%	33%

* Roger Shafer, "Use of a Recirculating Textile Filter followed by a Polishing Sand Filter for Onsite Wastewater Treatment in Colorado's Fractured Bedrock Environment," presented at the Colorado Professional Onsite Wastewater 2008 Education Conference.

** Five septic effluent samples were collected from the system between April and May 2001 using a 3/4-in. clear plastic tank sampler. Samples were collected from the outlet tee of the septic tank before installation of the AdvanTex system.

Pennsylvania Testing Program

(Third-Party)

About the Testing: This test was performed as required by the State of Pennsylvania under its Technology Verification Program. NSF International is the third party that was contracted with to oversee the testing. The test involved AX20 systems installed at 11 single-family homes.

Dates: September 2005-2008

Location: Pennsylvania

Average Daily Flow: 100-300 gpd

System Configuration: AX20 Combo Mode recirculating into the primary compartment and secondary compartment of a 1500-gallon processing tank

Processing Tank Influent

	Total N (mg/L)	NH₃ (mg/L)
Mean	54	42
Median	43	31
Number of Samples	42	38

AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)
Mean	17	1.7
Median	16	0.6
Number of Samples	212	213
Percent Reduction	68%	96%

Virginia Approval Testing Program

(Third-Party)

About the Testing: Conducted by Mark Gross, P.E., Ph.D., of the University of Arkansas Department of Civil Engineering, this testing program involved AX20 systems installed at 13 single-family homes, which were sampled for 18 months.

Dates: October 2002-2006

Location: Virginia

Average Daily Flow: 90-308 gpd

System Configuration: AX20 Mode 1 (1 site) recirculating into a recirculating tank located after a separate primary septic tank; AX20 Mode 3 (12 sites) recirculating into the primary compartment of a 1500-gallon processing tank

AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)
Mean	15	1.8
Median	12	0.4
Number of Samples	84	84

**Jefferson County Health Department
Operating Permit Testing**

(Second-Party)

About the Testing: Orenco distributor Roger Shafer sampled 43 systems at single-family residences as required by the Jefferson County (Colorado) Health Department as an operating permit requirement.

Dates: October 2003-May 2006

Location: Colorado

System Configuration: Four AX20 systems and thirty-nine AX30 (AX20 and AX10) systems were all configured as Mode 3, recirculating into the primary compartment of a processing tank

AdvanTex Effluent*

	AX30 Total N (mg/L)	AX20 Total N (mg/L)
Mean	15	15
Median	16	14
Number of Samples	124	16

* For the 41 sites that have more than one sample

Skaneateles Demonstration Project

(Third-Party)

About the Testing: This testing was performed as part of the Skaneateles Demonstration Project. The purpose of this project was to evaluate the performance and management of innovative technologies on single-family residences. As part of this project, two AX20 systems were installed at single-family residences and tested.

Dates: November 2004-January 2007

Location: New York

Average Daily Flow: 106 gpd

System Configuration: AX20 Mode 1 recirculating into the second compartment of a 1500-gallon processing tank

Mode 1 Systems, AdvanTex Effluent

	Total N (mg/L)	NH₃ (mg/L)	Total P (mg/L)
Mean	14	0.9	10
Median	14	0.9	10
Number of Samples	18	18	18

FIELD TESTING

La Pine National Demonstration Project

(Third-Party and First-Party)

About the Testing: The project was a cooperative effort by the Deschutes County Environmental Health Division, the Oregon Department of Environmental Quality, and the U.S. Geological Survey. The purpose was to evaluate innovative denitrification technologies in an area of the state where climate and soil conditions are unfavorable for denitrification and the risk of groundwater contamination is high. As part of the project, three AX20 systems were installed at single-family residences. In addition to the required project samples, some samples were collected by Orenco.

Dates: January 2002-July 2004

Location: Oregon

Average Daily Flow: 108-334 gpd

System Configuration: AX20 Mode 3 recirculating into the primary compartment of a 1500-gallon processing tank

Septic Tank Effluent*

	Total N (mg/L)	NH ₃ (mg/L)	Total P (mg/L)
Mean	66	-	11
Median	63	-	10
Number of Samples	427	-	429

* Average of all other sites when the septic tank effluent is being sampled.

Mode 3 Systems, AdvanTex Effluent

	Total N (mg/L)	NH ₃ (mg/L)	Total P (mg/L)
Mean	17	1.9	9
Median	16	0.8	9
Number of Samples	57	57	68
Percent Reduction	74%	-	18%

Rhode Island Demonstration Project — Green Hill Pond Watershed

(Third-Party)

About the Testing: The University of Rhode Island Cooperative Extension On-Site Wastewater Training Center constructed and tested several innovative septic systems, including five AdvanTex systems, in the Green Hill Pond Watershed. The Training Center evaluated the systems' performance and used the installations to train installers, homeowners, designers, and regulators.

Dates: August 2003-December 2004

Location: Rhode Island

System Configuration: The project includes five AX20s at single-family homes, all configured as Mode 3, recirculating into the primary compartment of a 1500-gallon processing tank.

Mode 3 Systems, AdvanTex Effluent(

	Total N (mg/L)	Total P (mg/L)
Mean (all sites)	18	9
Median	17	10
Number of Samples	24	24

North Carolina Approval Testing Program

(Second-Party)

About the Testing: This test, conducted under state oversight, involves 15 AdvanTex systems at single-family homes and vacation rentals. The data include results from both AX20 and AX100 systems.

Dates: August 2003-June 2006

Location: North Carolina

Average Daily Flow: 75-2200 gpd

System Configuration: AX20 Mode 1 and Mode 3 and AX100. All systems except ones were configured as Mode 1 with recirculation into a recirculation tank located after a separate primary septic tank. A single system was configured as Mode 3 with a single processing tank.

Mode 1 Systems, Septic Tank Effluent

	TKN (mg/L)
Mean	66
Median	68
Number of Samples	26

Mode 1 Systems, AdvanTex Effluent

	Total N (mg/L)
Mean	26
Median	25
Number of Samples	95
Percent Reduction	63%

Mode 3 Systems, AdvanTex Effluent

	Total N (mg/L)
Mean	15
Median	13
Number of Samples	5

Maryland Best Available Technology Field Verification, AX20 & AX20-RT

(Third-Party)

About the Testing: As part of Maryland's "Best Available Technology" program, field verification testing was performed on AdvanTex AX20 and AX20-RT treatment systems to qualify them for the "Best Available Technology for Nitrogen Removal" designation. As part of this testing, twelve single-family residences were selected for installation of AX20 systems and twelve single-family residences were selected for installation of AX20-RT systems. Individual systems were sampled on a quarterly basis for one year.

Dates: May 2008-March 2010 (AX20), August 2010-March 2012 (AX20-RT)

Location: Maryland

Average Daily Flow: 90-400 gpd (AX20), 100-400 gpd (AX20-RT)

System Configuration: Mode 3 (AX20 and AX20-RT)

Mode 3 Systems, AdvanTex Effluent (AX20)

	Total N (mg/L)
Mean	18
Median	14
Number of Samples	48

Mode 3 Systems, AdvanTex Effluent (AX20-RT)

	Total N (mg/L)
Mean	15
Median	14
Number of Samples	48