

# AdvanTex® Performance Summary #2

## Nutrient Reduction: TN, NH<sub>3</sub>, 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 (NH<sub>3</sub>), and Total Phosphorous (TP). The results show that AdvanTex systems easily meet advanced treatment standards for nitrogen and total phosphorous.

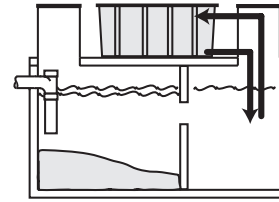
### About System Configurations

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.

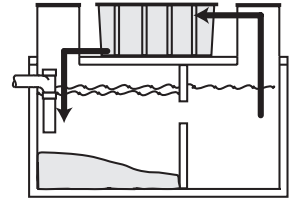
In Virginia, North Carolina, and Rhode Island, some of the systems tested in Mode 1 incorporated two tanks: a primary tank and a recirculation tank. In the primary tank, sludge and scum are separated from liquid effluent, which then flows into a separate recirculation tank, into which the AdvanTex filtrate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

### About the Results

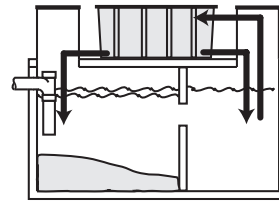
The table below summarizes effluent testing results for Total Nitrogen, Ammonia, and Total Phosphorous, both from test center programs and field testing programs. The pages that follow provide more specific results of these testing programs. For ease of comparison, we have also included information about 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.



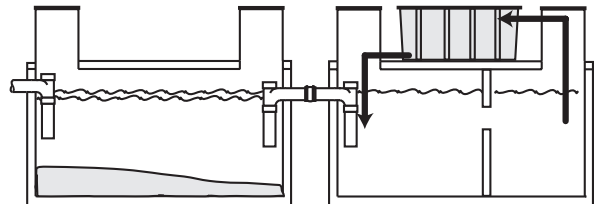
Mode 1 with processing tank



Mode 3 with processing tank  
(Optimized for denitrification)



Combo Mode with processing tank



Mode 1 with primary tank and recirculation tank

### TEST CENTERS SUMMARY

<b>AdvanTex Effluent Averages</b>	<b>Total N (mg/L)<sup>1</sup></b>	<b>NH<sub>3</sub> (mg/L)</b>	<b>Total P (mg/L)</b>	<b>Duration</b>
NSF/ANSI Standard 40 Testing	12 (64%) <sup>2</sup>	0.9 (96%)	-	7 months
NSF/ANSI Standard 40 Testing with UV Disinfection	13 (66%)	1.1	-	6 months
Novatec Nitrogen Removal Testing	10 (70%)	-	-	1 year
Rotorua District Council Approval Testing	13 (82%)	0.2 (99%)	8 (33%)	13 months

### FIELD TESTING SUMMARY

<b>AdvanTex Effluent Averages (# of SFRs)<sup>3</sup></b>	<b>Total N (mg/L)</b>	<b>NH<sub>3</sub> (mg/L)</b>	<b>Total P (mg/L)</b>	<b>Duration</b>
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) <sup>4</sup>	26 (63%)	-	-	2 years, 10 months
North Carolina Approval Testing Program — Mode 3 (1)	15	-	-	2 years, 10 months

<sup>1</sup> TN = TKN + NO<sub>3</sub>-N + NO<sub>2</sub>-N

<sup>2</sup> Percent Reduction

<sup>3</sup> SFR = Single-family residences

<sup>4</sup> Includes single-family residences and vacation rentals

**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**

	<i>Total N (mg/L)</i>	<i>NH<sub>3</sub> (mg/L)</i>
<b>Mean</b>	<b>34</b>	<b>22</b>
Median	33	23
Number of Samples	21	21

**AdvanTex Effluent**

	<i>Total N (mg/L)</i>	<i>NH<sub>3</sub> (mg/L)</i>
<b>Mean</b>	<b>12</b>	<b>0.9</b>
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**

	<i>TKN (mg/L)</i>
<b>Mean</b>	<b>38</b>
Median	40
Number of Samples	22

**AdvanTex Effluent**

	<i>Total N (mg/L)</i>	<i>NH<sub>3</sub> (mg/L)</i>
<b>Mean</b>	<b>13</b>	<b>1.1</b>
Median	12	0.6
Number of Samples	20	22
Percent Reduction	66%	-

**Novatec Consultants, Inc. Nitrogen Removal Testing**

*(Third-Party)*

**About the Testing:** After completion of the NSF/ANSI Standard 40 testing, Orenco contracted with Novatec to evaluate denitrification performance of the same AX20 system in Mode 3. Composite sampling was used throughout this evaluation.

**Dates:** December 2002-December 2003

**Location:** British Columbia

**Average Daily Flow:** 250 gpd

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

**Processing Tank Influent**

	<i>Total N (mg/L)</i>
<b>Mean</b>	<b>33</b>
Median	33
Number of Samples	5

**AdvanTex Effluent**

	<i>Total N (mg/L)</i>
<b>Mean</b>	<b>10</b>
Median	10
Number of Samples	25
Percent Reduction	70%

**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 of the project was to compare systems so that manufacturers that meet their specifications can be preapproved. The 13-month trial was focused particularly on nitrogen reduction.

**Dates:** May 2005-June 2006\*

**Location:** New Zealand

**Average Daily Flow:** 265 gpd

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

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

**Processing Tank Influent**

	<i>Total N (mg/L)</i>	<i>NH<sub>3</sub> (mg/L)</i>	<i>Total P (mg/L)</i>
<b>Mean</b>	<b>72</b>	<b>49</b>	<b>12</b>
Median	71	49	12
Number of Samples	-	-	-

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**AdvanTex Effluent**

	Total N (mg/L)	NH <sub>3</sub> (mg/L)	Total P (mg/L)
<b>Mean</b>	<b>13</b>	<b>0.2</b>	<b>8</b>
Median	13	0.2	8
Number of Samples	41	-	-
Percent Reduction	82%	99%	33%

**FIELD TESTING**

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

(Second-Party)

**About the Testing:** This 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)
<b>Mean</b>	<b>38</b>	<b>9</b>
Number of Samples	5	5

**AdvanTex Effluent**

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

\* Roger Shafer, "Use of a Recirculating Textile Filter followed by a Polish-ing Sand Filter for Onsite Wastewater Treatment in Colorado's Frac-tured 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 Penn-sylvania 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 com-partment and secondary compartment of a 1500-gallon processing tank.

**Processing Tank Influent**

	Total N (mg/L)	NH <sub>3</sub> (mg/L)
<b>Mean</b>	<b>54</b>	<b>42</b>
Median	43	31
Number of Samples	42	38

**AdvanTex Effluent**

	Total N (mg/L)	NH <sub>3</sub> (mg/L)
<b>Mean</b>	<b>17</b>	<b>1.7</b>
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) recir-culating into the primary compartment of a 1500-gallon processing tank.

**AdvanTex Effluent**

	Total N (mg/L)	NH <sub>3</sub> (mg/L)
<b>Mean</b>	<b>15</b>	<b>1.8</b>
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)
<b>Mean</b>	<b>15</b>	<b>15</b>
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**

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

**La Pine National Demonstration Project**

*(Third-Party and First-Party)*

**About the Testing:** This project is a cooperative effort by the Deschutes County Environmental Health Division, the Oregon Department of Environmental Quality, and the U.S. Geological Survey. The purpose of the project is 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 samples required for the project, 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\***

	<b>Total N (mg/L)</b>	<b>NH<sub>3</sub> (mg/L)</b>	<b>Total P (mg/L)</b>
<b>Mean</b>	<b>66</b>	-	<b>11</b>
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**

	<b>Total N (mg/L)</b>	<b>NH<sub>3</sub> (mg/L)</b>	<b>Total P (mg/L)</b>
<b>Mean</b>	<b>17</b>	<b>1.9</b>	<b>9</b>
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 is testing several innovative septic systems, including five AdvanTex systems, in the Green Hill Pond Watershed. The Training Center is evaluating the systems' performance and using 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**

	<b>Total N (mg/L)</b>	<b>Total P (mg/L)</b>
<b>Mean (all sites)</b>	<b>18</b>	<b>9</b>
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. Except for one system, all 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**

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

**Mode 1 Systems, AdvanTex Effluent**

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

**Mode 3 Systems, AdvanTex Effluent**

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