CES
COMMUNITY ENVIRONMENTAL SERVICES, INC.
2101 South IH-35, Suite 400
Austin, TX 78741
Ph: (512) 443-2733 FAX: (512) 444-2313
www.ces-txvi.com

Aerated Tank Units (ATU's)

Aerated tank units (also referred to as "aerobic treatment units", or ATU's) are a treatment option which gained widespread use during the past twenty to thirty years for small scale decentralized wastewater systems. The treatment units use a suspended growth treatment process, which is used for many municipal or large-scale "package" treatment plants. Tanks constructed of polyethylene, fiberglass (FRP), or concrete are used, with aeration of wastewater in the tank provided through one or more of a variety of delivery methods. Modifications have been made to some aerated tank units over time to enhance performance. A number of studies have been conducted on the performance of ATU's over the years, sometimes in response to reports of problems.

Some method of disinfection must be used following an ATU if effluent is to be surface irrigated, and typically chlorination with a stack-feed chlorinator is used. Some studies have shown that disinfection may not sufficiently occur in many cases following ATU's, due to a variety of factors. These include variability of effluent quality including BOD, TSS, and ammonia levels, along with failures to provide sufficient maintenance to the systems.

The 2002 EPA *Onsite Wastewater Treatment Systems Manual* states the following about ATU's:
"CFSGAS [continuous-flow, suspended-growth aerobic systems] must be managed and maintained by trained personnel rather than homeowners to perform acceptably. Power requirements vary from 2.5 to 10 kWh/day. They should be inspected at least every 2 to 3 months. During these inspections, excess solids pumping should be based on the mixed liquor measurements. It is estimated that an effective program will require between 12 and 28 person-hours annually, in addition to analytical testing of the effluent, where required. Management contracts should be in place for the life of the system. Common operational problems with extended aeration systems are provided in table 2. [See below] Residuals generated will vary from 0.6 to 0.9 lb TSS per lb BOD removed, over and above the normal septic tank sludge produced."

Common operational problems cited for extended aeration package plants include:

"Excessive local turbulence in aeration tank";
"White, thick, billowy foam on aeration tank";
"Thick, scummy, dark tank foam on aeration tank";

"Dark brown/black foam and mixed liquor in aeration tank";
"Billowing sludge washout in clarifier";
"Clumps of rising sludge in clarifier";
"Fine dispersed floc, turbid effluent";
"Poor TSS and/or BOD removal";
"Poor nitrification".

All of the above problems require attention by trained and/or licensed service personnel (including wasting/pumping sludge from the tank). With many local onsite wastewater service providers charging $50 or more per hour for service calls, costs for maintenance on these systems can potentially be very high annually. For the EPA estimate of 12 to 28 person-hours annually, and if hourly rates ranged from $30-$50/hour, annual maintenance costs could range from $360 to $1,400 annually, not including analytical testing or septage pumping costs if/as needed.

Recommendation: More protective secondary treatment standards should be adopted that will require all proprietary and non-proprietary treatment processes to perform adequately for public and environmental health protection. If ATU's are to be used for individual residences, cluster systems and small commercial applications, and are found to comply with acceptable performance standards, several features are recommended for their use:

Adequate primary treatment (usually with a septic tank) must be provided prior to secondary treatment with either an ATU or other treatment process;
Timed dosing should be carried out during the day (at least 10 to 12 doses per day) to achieve better flow equalization;
Sufficient pump tank capacity must be provided to accomplish timed dosing;
A screened effluent pump vault in the timed dosing tank should be used leading to the ATU.

An annotated bibliography of ATU performance studies and articles is provided on the following pages.

This bibliography includes studies of the performance of aerobic treatment units (ATU's) in various areas of the United States.

Brewer, W.S., et al. "An Evaluation of the Performance of Household Aerobic Sewage Treatment Units." Journal of Environmental Health, Vol. 41, No. 2 (1978), pp. 82–85. **Ohio**
"The number of units with poor effluent quality represented 41.2 percent of the total [51] units examined
. . . . In 12 of the 21 units with poor effluents, all three components (aerator, diffuser, and timer) were nonfunctional. . . . Nearly one-third of the units inspected had at least one mechanical component that was nonfunctional."

Gustafson, D., et al. "Choosing an Alternative Septic System for a Homesite with a Steep Slope." University of Minnesota Extension Service, Publication FO-7570-B (2000). **Minnesota**
"[In ATUs,] All of the mechanical pieces need to be correctly maintained for proper treatment to occur. . . . Electrical costs are usually higher than those of the other systems."

Hanson, A., et al. "Alternative Small-Flow Wastewater Technologies in the Arid Southwest." Small Flows Quarterly, Vol. 3, No. 3 (Summer 2002). **New Mexico**
"This study suggests that requiring maintenance contracts on advanced systems is not sufficient to ensure consistent high-quality treatment."

Hutzler, N.J., et al. "Performance of Aerobic Treatment Units," in Proceedings of the 2nd National Home Sewage Treatment Symposium, St. Joseph, Michigan: American Society of Agricultural Engineers (1978), pp. 149–163. **Kentucky, Maine, Wisconsin**
"The service reports of 36 randomly selected units [in Maine] representing 18 months of inspection (386 total visits) were analyzed . . . .

Status of unit during visit	*Number of visits*	*Percentage of total*
Mechanically satisfactory and meeting standards	*213*	*55%*
Mechanically satisfactory and not meeting standards	*81*	*21%*
Mechanically unsatisfactory	*92*	*24%"*

Kellam, J., et al. "Evaluation of the Performance of Five Aerated Package Treatment Systems." Bulletin 178. Blacksburg, Virginia: Virginia Water Resources Research Center, Virginia Polytechnic Institute and State University. (1993) **Virginia**
"Effluent BOD_5, SS, and FC samples exceeded the state's proposed standards 60–80% of the time. The poor field performance was a function of improper operation by homeowners, an ineffective chlorinator/dechlorinator system, inadequate biological treatment, and mechanical malfunctions. . . . Inspections should be made at least four times per year for the system's lifetime . . . ."

Mancl, Karen, M.S., Ph.D. and Vollmer, Michael, L.E.H.P. "Management of Individual Mechanical Sewage-Treatment Systems: How Much Is Needed?" Journal of Environmental Health, Vol. 63, No. 9, (May 2001), pp. 22-25. **Illinois**
"In 1997, 67 percent of the individual mechanical sewage-treatment systems discharging in Will County, Illinois, were in violation of at least one discharge standard. The overall cost of management, shared by the homeowners and the county health department, ranged from $350 to $725 per year.

Maxfield, Meliss, R.E.H.S./R.S., M.P.H., et al. "Aerobic Residential Onsite Sewage Systems: An Evaluation of Treated-Effluent Quality." Journal of Environmental Health, Vol. 66, No. 3 (October 2003), pp. 14-19. **Washington**
"Although ATUs are certified through NSF according to a rigorous testing protocol, the results obtained during such testing do not appear to be reflective of in-the-field results found by this and other studies. . . .[I]t is significant that effluent from ATUs analyzed in this research did not meet state or national requirements more than 60 percent of the time and that most of the systems were no more than 12 months old at the time of sampling."

Otis, R.J. and Boyle, W.C. "Performance of Single Household Treatment Units." Journal of the Environmental Engineering Division, American Society of Civil Engineers, Vol. 102 (February 1976), pp. 175-189.
"To maintain a high quality effluent from aerobic units, the following design features and operational procedures appear to be desirable based on this study: (a) A septic tank or trash trap preceding the aeration chamber to remove grease, floating solids and large debris; . . . (d) a heat source to maintain mixed liquor temperatures above 15 °C in temperate climates; . . . and (f) regular and competent maintenance for the aerobic units with inspections made at least every 2 months. Sludge removal from aerobic units is required every 8 months–12 months."

Seabloom, Robert W. "University Curriculum Development for Decentralized Wastewater Management: A Preliminary Report on Aerobic Treatment Units." National Decentralized Water Resources Capacity Development Project, www.ndwrcdp.org.
"Very few of the available package plants have adequate secondary clarifier surface area to provide the necessary settling capacity to prevent the carry over of solids. . . . The activated sludge process is considered by almost all U.S. and international experts to be the most difficult to operate and maintain, of all the various wastewater treatment concepts. . . . Claims about the performance of these small units have regularly been overly optimistic. It is true if the plants are properly sized, operated and maintained, they may provide satisfactory treatment of small wastewater flows. However, there are inherent design flaws that frequently preclude the continuous satisfactory treatment of the wastewater."

Sexstone, Alan, Ph.D., et al. "A Survey of Home Aerobic Treatment Systems Operating in Six West Virginia Counties." Small Flows Quarterly, Vol. 1, No. 4 (Fall 2000), pp. 38–46. **West Virginia**
"Ninety-two percent of West Virginia ATU systems appear to be discharging effluent of unacceptable quality. . . . West Virginia ATU systems with no maintenance deficiency exceeded TSS and/or BOD_5 limits 31 percent of the time. . . . There is a pronounced

difference between the positive public perception of West Virginia ATU systems effectiveness and their actual performance."

Thayer, Dennis, ADEQ-YCES (Arizona Department of Environmental Quality—Yavapai County Environmental Services) Aerobic Systems Survey, 1996-1997. Prescott, Arizona (Aug. 22, 1997). **Arizona**
"We believe that these systems are exceptionally vulnerable to the daily upsets that can occur from day to day. Upsets such as hydraulic overloads, chemical imbalances or toxicity in influent, power failures, etc. can all contribute to conditions within the plant that are difficult to recover from without the intercession of an operator or other knowledgeable individual. In addition, the simple but maintenance intensive operation of chlorination is often overlooked by the homeowner, and is difficult for an operator on a monthly or quarterly visit to keep up to standard."

Tully, Ian, et al. "Performance Evaluation of On-Site Aerated Wastewater Treatment Systems, 1995–1998." (2001) Brisbane, Queensland, Australia: Department of Natural Resources and Mines. **Australia**
"Overall compliance with DNR's approval criteria of 20 mg/L BOD_5, 30 mg/L SS and <1000 thermotolerant coliforms/100 mL was poor. Only 32% of the 216 plants tested complied with all three criteria." [Since sand filters were included in the study, and 15 out of 16 of them were in compliance, the compliance rate of mechanical ATUs was actually lower than 32%.]

U.S. Environmental Protection Agency. EPA Onsite Wastewater Treatment Systems Manual. "Chapter 4: Treatment Processes and Systems," "4.8.6 Costs." (February 2002), p. 4-55.
"Installed ATU costs range from $2500 to $9000 installed. Pumping may be necessary at any time due to process upsets, or every eight to twelve months, depending on influent quality, temperature, and type of process. Pumping could cost from $100 to $300, depending on local requirements. Aerators/compressors last about three to five years and cost from $300 to $500 to replace. Many communities require service contracts. These contracts typically range in cost between $100 and $400 per year, depending on the options and features the owners choose. The high end includes pumping costs. Power requirements are generally quoted at around $200/year."

U.S. Environmental Protection Agency. EPA Onsite Wastewater Treatment Systems Manual. "Onsite Wastewater Treatment Systems Technology Fact Sheet 1: Continuous-Flow, Suspended-Growth Aerobic Systems (CFSGAS)." (February 2002) pp. TFS1–TFS7.
"Sludge removal: 3–6 months as needed. . . . Power requirements vary from 2.5 to 10 kWh/day. They should be inspected at least every 2 to 3 months. . . . It is estimated than an effective program will require between 12 and 28 person-hours annually, in addition to analytical testing of the effluent, where required. Management contracts should be in place for the life of the systems. . . . CFSGAS systems . . . . are quite sensitive to temperature, interruption of electric supply, influent variability, or shock loadings of toxic chemicals. . . . Aesthetically, noise from the blowers is the major irritant, while odors can be significant during power outages or organic overloading periods. . . . The systems are not well suited to seasonal use because of long start-up times."

Zachritz, W.H., et al. “Evaluation of Onsite Wastewater Treatment and Disposal: Demonstration of Alternative Technologies. Final Report, Volume II.” (2000) Bernalillo County, New Mexico, Environmental Health Department. **New Mexico**
“Aeration systems . . . associated with the mechanical aerobic units were a noticeable weakness and the partial or full failure of this part of the system resulted in very poor system performance. Rigorous inspections must be performed and air supply units pressure-tested to assure their operability. Solids wasting in aerobic systems (biosystems) needs to be performed on a regular basis, as well as regular maintenance (every 6 months pump 200 gallons and check system components).”