Texas On-Site Insights
Information about On-Site Wastewater Treatment Systems in Texas
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2nd Annual On-Site Conference Draws 300 Participants

More than 300 persons participated in the Second Annual Conference of the On-Site Wastewater Treatment Research Council. The meeting took place in Austin on October 10-12.

The meeting, titled "Breaking New Ground," attracted 27 speakers. Keynote talks were delivered by Congressman Greg Laughlin (who made his presentation via a videotape), Council Chairman Bill Harris of the Texas Agricultural Extension Service, and Nancy Worst of the Texas Natural Resource Conservation Commission (TNRCC). A panel discussion gave participants the opportunity to ask questions and offer comments on the Council programs and other on-site wastewater issues. Panel members included officials from the TNRCC, the Environmental Protection Agency, the Lower Colorado River Authority, and the Austin-Travis County Health Department.

Technical presentations focused on such topics as the use of cluster systems, sand filters, shallow drainfields and constructed wetlands for wastewater treatment. Other talks provided information on the remediation of failed systems, benefits of rainwater harvesting, how conservation can improve system performance, and communicating on-site wastewater issues. Case studies were presented on how on-site systems performed near Lake Livingston and Galveston Island, and innovative technologies that are being utilized along the Texas-Mexico border. The meeting also featured 28 exhibits by companies and organizations. Many of the exhibitors demonstrated the use of their technologies. The Proceedings from the conference are now available for $10 by calling Teri Chapman at (512) 322-3656.

TNRCC Survey Shows that Small Lot Sizes, Surfacing Sewage Are Major On-Site Concerns

Results of a recent survey by the On-Site Wastewater Team at the Texas Natural Resource Conservation Commission (TNRCC) provide some insights into what local regulatory officials feel are the state's major on-site wastewater problems and opportunities.

The survey was mailed in May, 1993, to 200 "designated representatives" and agencies that regulate and administer on-site programs at the local level. Roughly 56% of those surveyed sent back responses.

The most common complaint (69%) was that lots were too small for systems, followed by surfacing sewage (57%), lack of knowledge by homeowners about their systems (57%), and failing or malfunctioning systems (55%).

Potential solutions were also identified. The most often mentioned solution was public education (75%), followed by education of justices of the peace and county commissioners (43%), more comprehensive training for installers (38%), and more in-depth training for inspectors (39%).

The survey was conducted by the On-Site Wastewater Team, which is part of TNRCC's Flood Management and Groundwater Programs Section. Section manager Warren Samuelson hopes the results will guide the team so that their programs will respond to local concerns.

Samuelson can be reached at (512) 463-8575.

NOWRA, TOWA Meet in Fort Worth

National and statewide organizations that are active in on-site wastewater issues held a joint meeting in Fort Worth in November. Roughly 200 regulatory officials, engineers and soil scientists took part in the meetings.

The Texas On-Site Wastewater Association (TOWA) and the National On-Site Wastewater Recycling Association (NOWRA) held joint meetings in Fort Worth Nov. 4-6.

The NOWRA meeting included technical presentations on high strength waste treatment, performance-based standards that are being used in Wisconsin, maintaining the structural strength of septic tanks, and other issues. Continuing education seminars were also conducted. A field tour of North Texas sites that utilize innovative on-site treatment methods such as aerobic systems, spray and drip irrigation, and leaching chambers provided participants with first hand-experiences. One of the major efforts that may result from the NOWRA meeting is the formation of task forces that will work on developing an industry "model code" that would set standards for septic tanks, pumps and controls, and soil testing methods. NOWRA also held elections for its Board of Directors. Texans who were elected to the NOWRA board include Sherman Hart of the Texas Natural Resource Conservation Commission, Gig Drewery of Hydroflow Wastewater Treatment in Kounze, and Randall Scott of Scott Construction in Grandbury.

Following the technical presentations, TOWA conducted its business meetings and elected new officers and Board members for 1994. John Blount of the Harris County Engineer's Office was elected President, Maurice Short of Cardinal Engineering in Texarkana is the Vice President, Bruce Lesikar of the Texas A&M University Agricultural Engineering Department was voted as the Secretary, and Rick Goldberg of Wastewater Systems of Texas was chosen as the Treasurer. The Board was expanded to include 22 members who represent industry representatives, designers, installers, regulators, pumpers, engineers, sanitarians, and scientists. One of the immediate goals of

TOWA is to provide comments on the new State on-site wastewater regulations, which are expected to be released shortly.

NOWRA can be reached at (813) 644-3228. More information on TOWA can be obtained by calling Blount at (713) 956-3000.

A&M Researchers Demonstrate Subsurface Drip Irrigation in Lower Rio Grande Valley

Researchers with the Texas A&M University System are demonstrating the use of subsurface drip irrigation for the application of wastewater in the Lower Rio Grande Valley.

Scientists collaborating in the study include Bruce Lesikar and Guy Fipps of the Texas A&M University Agricultural Engineering Department, and Bob Wiedenfeld of the Texas A&M Agricultural Research and Extension Center in Weslaco. The project is funded by the Texas Agricultural Extension Service.

The purpose of the study is to demonstrate the use of subsurface drip irrigation for the application of effluents, and to evaluate soil moisture relationships in the drip fields. Subsurface drip irrigation provides for uniform distribution of effluents throughout the drip field. The application rate was determined using Texas' water use guidelines for irrigation with reclaimed water. Using climate data for Weslaco, the average annual application rate was determined to be 0.06 gallons per square foot per day (see Table). This application rate meets or exceeds the water requirements of Bermuda grass for five months of the year and provides half the water needs for May, June and July. The evaluation of the soil moisture relationship will be a key to determining if irrigation requirements are appropriate for determining application rates for on-site systems.

Monthly Water Requirements for Bermuda Grass in Weslaco, TX

Month	Amount of Water Required	
	Inches per day	Gallons per square foot per day
January	0	0
February	0.03	0.02
March	0.08	0.05
April	0.10	0.06
May	0.18	0.11
June	0.18	0.11
July	0.24	0.15
August	0.10	0.06
September	0.10	0.06
October	0.12	0.07
November	0.06	0.04
December	0	0
Average	**0.10**	**0.06**

The drip irrigation system is part of an integrated system that consists of a septic tank and a gravel marsh, which were installed earlier this year. A chlorination system will be installed to disinfect wastewater as it leaves the gravel marsh and flows into the drip system. The effluents are then filtered before they enter the drip system.

This drip irrigation field is being installed in Weslaco as part of an integrated system that includes constructed wetlands.

In November, the researchers installed two 1,000 square foot drip fields. Drip lines were installed at a depth of 3 inches in a fine sandy loam soil. The system will be able to treat 120 gallons per day based on an application rate of 0.06 gallons per square foot per day. Two types of emitters are being tested: a pressure-compensating drip emitter that uses a flexible membrane, and a turbulent flow emitter that makes the water snake through a maze-like pattern before it exits. The purpose of the emitters is to transport the water from inside the drip lines (where pressures range from 20 to 30 pounds per square inch) to the soil that surrounds the drip lines (where the pressure is near zero).

In the study, the researchers will monitor water movement. Soil-moisture will be measured below the drip lines with sensors. Strategies to control salinity will be developed and the optimal application rates will be identified. Lesikar said he believes the system could be ideal for facilities like small groups of homes that are tied into cluster systems, schools, and convention centers.

For more information, call Lesikar at (409) 845-7543.

Use of Alternative Aerobic On-Site Systems Near Lake Livingston

By Bobby Carlisle, Carlile and Associates, College Station, TX, and Mark Waters, Registered Sanitarian, Trinity River Authority, Lake Livingston, TX

For most of the residents near Lake Livingston, traditional septic tanks just won't function effectively. One problem is that a large number of homes have been built on sites too near the lake. Other factors that lead to septic tank malfunctions include clay soils, steep slopes, and heavy Spring and Fall rains that cause water-logged soils and high water tables. As a result, more than 80% of the sites near the lake are not suitable for the effective use of septic tanks.

To better protect the water quality of the lake, TRA staff are working with private consultants to evaluate alternative systems that might perform better in the area.

Some of the most promising systems that have been identified are aerobic treatment and disinfection units, followed by surface spray irrigation or underground drip irrigation.

Some homeowners near Lake Livingston are converting existing drainfields to drip irrigation systems like this one (above) because of space and soil constraints.

Many of the systems that appear to work best near the lake are conventional septic tanks that have been retrofitted with aerobic units and irrigation systems to provide additional treatment. Aerobic units provide oxygen by mechanically stirring or aerating raw wastes and wastewater. This encourages rapid and complete decomposition of organic matter and pathogens. Treated effluents are later disinfected with chlorine. They can then be pumped to surface spray irrigation systems or underground drip lines where they can provide water for landscape irrigation. Surface irrigation can often be accomplished through the use of pop-up spray nozzles. In sites where surface irrigation is not practical, subsurface drip irrigation lines can be installed. Drip systems typically apply wastewater at pressures ranging from 25 to 30 pounds per square inch (psi).

During the past two years, TRA has collected monthly samples from 81 aerobic systems near the lake. Samples have regularly been taken from 500-gallon aerobic treatment plants serving individual homes, and 1500-gallon aerobic units that treat wastes from mobile home parks.

Test results show that all the samples met Texas Natural Resource Conservation Commission (TNRCC) standards for biochemical oxygen demands (BOD) and nearly all samples met TNRCC levels for total suspended solids (TSS). However, approximately 17% of the samples did not meet the TNRCC secondary effluent standards for disinfection and chlorine residuals. A main reason for this is that homeowners are responsible to add chlorine to disinfect their systems and many simply forget or neglect to do so.

In summary, aerobic systems followed by surface or drip irrigation have some notable advantages: 1) They can be effective in areas where site limitations such as shallow or

impermeable soils would cause septic systems to fail; 2) They are cost-competitive with other "alternative" systems, 3) They conserve water and encourage water reuse, and 4) They increase the amount of effluents that can be disposed of by promoting evapotranspiration. It needs to be noted that these systems also have their own disadvantages: 1) They require conscientious and expert maintenance; 2) Operational costs are higher, and 3) Homeowners must act responsibly to properly operate, maintain, and disinfect these systems if they are to work properly.

NOTE: This article was based on a presentation that was made at the Second Annual Texas On-Site Wastewater Treatment Research Conference.

Remediating Failed Septic Systems with Microbubble Aeration Units

By Terry Hoage, Biology Department, Sam Houston State University, Huntsville, TX; Paulene Johnson, Septic Hydro-Tech, Goodrich, TX; and Jerry Hoage, Sewage Aeration Systems, Lockridge, IA

A major environmental concern centers on pollution from failing on-site septic systems. The problem is particularly serious in low-lying areas along the Texas Gulf Coast that receive heavy rainfall and may not have suitable soils. An alternative may be to retrofit these failed systems with small-scale, low-energy aeration units that may increase oxygen transfer and treatment.

We have tested fine bubble aeration units (or "microbubble" diffusers). These systems generate a consistently high number of small bubbles that we have shown increase treatment by providing suitable conditions for the growth of microorganisms, increasing contact times, and promoting the transfer of dissolved oxygen.

These aerobic systems work well with existing septic tanks and may be especially useful at providing increased digestion rates and at lessening the amount of solids that flow into drainfields. These microbubble aerators are not a stand-alone treatment system, but can be added to existing permitted units.

The microbubble system we have evaluated introduces air into raw wastes by creating a vacuum at the end of a tube housing a shaft and a propeller. The propeller evacuates water from the tube shaft and creates a partial vacuum. The vacuum creates a large number of small bubbles or microbubbles that remain suspended for a long time period. Our tests suggest the system may provide better treatment than conventional septic tanks or other aerobic systems, because it produces high oxygen transfer rates that hasten the decomposition of organic wastes.

Case Studies

We have conducted some tests where fine bubble aeration units have been used with existing septic tanks. Most of the tests have been conducted in lakeside areas north of Houston where traditional septic tanks would not usually perform well because of problems with soils, steep slopes, or excess rainfall.

One study compared the level of treatment provided by an anaerobic two-tank system to treatment provided by an aerobic system that was equipped with a microbubble aerator. Results suggest that the aeration unit lowered biochemical oxygen demand (BOD) levels by 45%, total suspended solids (TSS) concentrations by 20%, and fecal coliform populations by 35%, compared to the treatment provided by the anaerobic system. Another study tested the performance of a single 500-gallon tank that was fitted with a baffle to separate the aeration chamber from the effluent chamber. Four doses of 75-gallons of raw wastes (nearly five times greater than normal levels) were pumped into the microbubble aeration chamber and then flowed to a 30 square foot sand filter. Aeration reduced BOD and TSS levels by 55% and cut fecal coliform bacteria populations by 77%. The sand filter provided additional treatment, lowering BOD concentrations by 80%, TSS levels by 73% and coliforms by 94%.

Prototype systems have also been developed. For example, a two-bedroom home that generates 300 gallons of wastewater a day might consist of a 750-gallon tank followed by a 60 square foot sand filter. These systems can be configured to convert an existing anaerobic septic tank to an aerobic system without having to add an additional tank.

Why the System Works

We have also attempted to document and quantify how various aerators increase oxygen levels. Oxygen transfer can be enhanced by creating a large number of tiny bubbles, which should increase the surface area and contact time. In one test, we installed a microbubble aerator in a 55-gallon glass tank that was nearly filled. The tank contained a small plastic window marked with a grid pattern so that the formation and activity of bubbles inside the tank could easily be observed and documented. The aerator was placed 2 feet away from the window, and the orifices were placed 1 foot below the surface. Using a water-tight camera that was placed in the plastic window two feet away from the tank, photographs were taken to determine the number and size of bubbles. The aerator was turned on for a minute and then turned off. A photo was taken of the bubbles that had collected on the window. Enlarged prints were used to count and measure the bubbles.

What do the results show and what do they mean? Microbubble aeration uses the vacuum created at the space between the propeller and holes in the 2" tube plate to condense air into very small 0.01" diameter bubbles. The system created 103 million cubic feet of bubbles in a 750-gallon tank every 24 hours. The bubbles produced more than 5.4 pounds of oxygen in the tank.

Studies conducted by the National Sanitation Foundation (NSF) in 1991 show that fine bubble aerators can be very effective at treating wastes. One NSF study showed that BOD levels were reduced from 660 ppm to less than 70 ppm in 24 hours. The importance of this research is that the large number of bubbles that were created enhanced "oxygen transfer efficiency" (the ratio of the amount of oxygen transferred by aeration versus the amount actually used for treatment). In this study, the oxygen transfer efficiency was calculated to be 98%.

Summary

We believe that is possible to renovate many existing septic systems that are now failing. Aerobic treatment units may be especially useful in areas where traditional septic tanks cannot function effectively. Units that utilize microbubble technology may be more effective than other aerobic systems because they trap more oxygen and transfer it effectively.

NOTE: Terry Hoage has studied the performance of "Aerob-a-Jet" treatment units. These units have been tested by the NSF, but are not approved as stand-alone treatment units in Texas. The TNRCC has approved the technology when it is used with other on-site systems. This article is not an endorsement of a particular technology by either the Council or the Texas Water Resources Institute. Hoage's full paper is included in the *Proceedings of the 2nd Annual Texas On-Site Wastewater Treatment and Research Council.*

Proceedings Highlights Texas On-Site Wastewater Issues

A proceedings that deals with on-site wastewater issues in Texas has been published by the Texas On-Site Wastewater Treatment and Research Council.

The proceedings, titled *We're Breaking New Ground*, contains papers that were presented at the Council's annual meeting in Austin in October 1993. It was edited by Teri Chapman and Chris Guzman of the City of Austin Water and Wastewater Utilities.

Topics covered in the proceedings include the use of cluster systems, sand filters, shallow drainfields and constructed wetlands. Other talks in the proceedings focus on the remediation of failed systems, benefits of rainwater harvesting, how conservation can improve system performance, and communicating on-site wastewater issues. Case studies are included that assess how on-site systems performed near Lake Livingston and Galveston Island, and innovative technologies that are being utilized along the Texas-Mexico border.

The proceedings can be ordered by calling Guzman or Chapman at (512) 322-3656.

UTEP Publishes Proceedings on Subsurface Flow Constructed Wetlands

The University of Texas at El Paso (UTEP) has published a conference proceedings that deals with the use of constructed wetlands for wastewater treatment.

Subsurface Flow Constructed Wetlands was published by the Center for Environmental Resource Management. It contains papers that were presented at a conference that was held at UTEP in August.

Papers deal with solving on-site wastewater treatment problems with small constructed wetland systems, developing design relationships for subsurface flow wetlands that treat domestic wastes, oxygen diffusion rates in static and recirculating rock plant filters, and the economics and performance of constructed wetlands in the Southwest. Other articles

in the proceedings cover topics such as performance attributes of submerged flow man-made wetlands, guidance and design considerations, and case studies from Nevada and Kentucky.

To order a copy or for more information, call Nancy Lowery at UTEP at 915/ 747-6648.

On-Site Computer Software Developed by Purdue University

Computer software packages that describe the basic principles of on-site wastewater treatment have been developed by Purdue University.

"RWASTE IV" was developed in 1992 by Don Jones, Joseph Yahner, Joseph Rogers, and Chris Rewerts of the Agricultural Engineering Department. It is designed to assist homeowners, county health districts, and contractors in determining the suitability of sites for septic tanks and other on-site systems. The program asks users to supply information on the type of soils, wastewater flow rates, depth to groundwater, topography and slope, and the dimensions of the site. The program including tables of loading rates to estimate hydraulic conductivity and allows systems to be designed "at grade" as well as trenches and mounds. The program determines if on-site systems are likely be successful based on specific conditions and can suggest system types and layouts.

"Principles and Design of On-Site Waste Disposal with Septic Systems" is a hypertext-based program that was written by Matthew Stuve, Richard Johnson, and Don Jones. It provides basic information how septic tanks work, site evaluation, construction planning, basic soil science, and ways to minimize wastewater flows. The program includes many graphics and animation that make the information easy to understand.

For details on either program, call (317) 494-1172.

Texas Water Development Board Programs that Can Provide Funding for On-Site Wastewater Systems

By Will Ed Winters
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Overview

Most of the Texas Water Development Board (TWDB) funding efforts are directed to larger communities for conventional sewage systems. Since 1989, the TWDB has committed more than $750 million to wastewater treatment works from the State Revolving Fund (SRF). Few of the projects have involved on-site systems, except for some small-diameter sewers. The TWDB will probably not get involved in funding large numbers of on-site systems in the near future, unless the Legislature gives us funding and direction to do so.

The TWDB does have some programs that can fund on-site systems in three main areas including: 1) Research of on-site systems, including basic science, performance, and operation and maintenance issues; 2) Planning for on-site systems, which consists of analyses of existing problems; and 3) Design, construction, maintenance and rehabilitation of these systems.

Programs that can fund on-site systems include the Colonia Plumbing Loan Program (CPLP), Economically Distressed Areas Program (EDAP), Colonias Wastewater Treatment Assistance Program (CWTAP), the SRF, Water Quality Enhancement Loan Program (WQEL), and the Research and Regional Facility Planning Program (RRFPP).

The CPLP, EDAP and CWTAP are available only to certain areas near the Texas-Mexico border. The other programs apply statewide. Project funding in the CPLP, EDAP, CWTAP, SRF and WQEL programs is available on a first-come, first-served basis. RRFPP funds are available only at certain times each year as funds are available.

The CPLP, EDAP, and CWTAP programs are intended for colonias. TWDB defines colonias as residential areas that have inadequate water service and/or wastewater facilities to meet the minimal needs of the residents, and inadequate financial resources. To be eligible for the CWTAP, colonias must be located in a border county and must be within 60 miles of the border. The CPLP is available in each border county except Kinney and Jeff Davis. To be eligible for the EDAP, the colonia must be located in a county which is adjacent to the border, or has low per capita incomes or high unemployment rates. Colonias had to be in existence as of June 1989 to be eligible for the program.

The CPLP is intended to grant loans to individuals in colonias so they can obtain adequate water and wastewater plumbing for their residences. The loans can be used to install on-site wastewater systems where it is not practical to connect to conventional systems. This program is locally run, so political subdivisions need to apply on behalf of a colonia and administer the program. So far, only the cities of Edinburg and Pharr and the county of El Paso have applied for and received commitments for CPLP funding. El Paso will likely make loans available to colonia residents for new or upgraded on-site systems. The TWDB is now seeking more participants for this program.

The EDAP and CWTAP both target colonias. EDAP funding can be used for on-site systems and other wastewater treatment works. CWTAP funding can be used only for the wastewater treatment works. The TWDB is authorized to issue up to $250 million in bonds to finance loans and grants for the EDAP. The enabling legislation for the EDAP program limits funding of centralized wastewater treatment works to cases where the TWDB determines that it is *not* feasible to use on-site systems. The law requires that the cost-effectiveness of innovative and non-conventional alternatives (on-site systems) be evaluated before construction is funded. EDAP monies may also be used to build drainage works that will help on-site systems function properly. The bottom line is that on-site systems are to be used in this program, if they are cost-effective solutions.

The CWTAP is to be used along with the EDAP. The TWDB has set aside $6 million for funding demonstrations and evaluations of innovative and alternative wastewater and disposal systems for colonias that are outside of incorporated communities. The TWDB is now processing applications for such projects and, if funds are available, may solicit additional proposals. TWDB now has people who work with colonias to help them secure funding for solving to their on-site problems.

The SRF was created by the federal government in 1987. It is a perpetual fund that may be used as a source of loans for construction of municipal wastewater treatment works, including on-site systems. It is intended for communities that have significant areas that utilize on-site systems. It may be a source of funding for cluster systems. The SRF is available only to political subdivisions that have the authority to own, operate and finance public treatment works.

The RRFPP was created in 1981 by the Texas Legislature. Since then, the TWDB has funded approximately $11.6 million for research and $6.8 million for regional planning. The Research Program is not intended to compete with the On-Site Wastewater Treatment Research Council's research program. So far, few research projects have been funded that deal with on-site wastewater. The Regional Facilities Planning Program can be used for wastewater treatment and collection studies. Generally, past planning studies have only incidentally included an analysis of problems and solutions relating to on-site systems.

Obstacles to Overcome

There are several constraints to TWDB funding of on-site systems. Most on-site projects are going to be relatively small, costing at most a few thousand dollars. The CPLP program is designed to accommodate these projects, but the other TWDB programs are not. Another constraint is that most of the TWDB programs require a political subdivision of the state or a non-profit corporation to apply for funding. Only the CPLP provides for loans to individuals, which occurs after a political subdivision obtains funding on behalf of a colonia. In the other programs, the political subdivisions may be limited to what they can actually own or to what they are willing and able to ensure will be properly constructed, operated and maintained. Texas' constitution constrains a city's public financing of facilities that benefit private parties, including privately owned on-site systems. A city can fund on-site systems if it is necessary to protect public health and safety. Cities may be able to directly fund private on-site facilities when they get grants and take responsibility to ensure that on-site systems will be adequately constructed, operated and maintained.

Some consultants and governmental officials have a general bias against on-site systems. Many consultants are not eager to do on-site system work because they can make more money by designing large conventional treatment systems. Multiple sites and owners create a greater risk that some systems will not work. Cities are reluctant to fund and manage on-site systems because large number of systems are involved that require regular monitoring and may malfunction.

Benefits of TWDB Participation

The main attraction of doing business with the TWDB is that we can save cities and other agencies money by arranging for grants or loans at interest rates that are lower than commercial markets. The TWDB has staff who are experts in financing the design and construction of wastewater treatment systems. The TWDB works with applicants to help implement projects. Most projects will require a certain amount of coordination and cooperation with other federal and state agencies. The TWDB staff networks with these agencies and can provide a valuable liaison service to applicants.

NOTE: This is a condensed version of a paper that was presented at the Second Annual On-Site Wastewater Treatment and Research Council meeting in Austin in October. Winters can be contacted for more information at (512) 463-8499.