NSF International Test Site a Necessary Component to a Safe Environment

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Manufacturers of onsite aerobic treatment units have a long road to travel before their products can become certified, and David Jumper is a leading navigator in the field to help them find their way.

Jumper, who runs the only official test site of the National Sanitation Foundation (NSF) International in Waco, Texas, follows an elaborate train of precise, detailed checkpoints before any unit is given the seal of approval. In addition, a continuing audit is performed once that certification is granted, to ensure a unit's ongoing performance.

David Jumper in front of the NSF testing facility at the Brazos River Authority sewage treatment facility in Waco, Texas. All photos courtesy of David Jumper.

The test site at Waco, originally associated with the Baylor University Environmental Studies Department, was developed in 1987. It is located at the sewage treatment facility in Waco, Texas, formerly known as the Brazos River Authority (BRA). The 30-million-gallon-per-day (gpd) plant changed hands in late February 2004 and is now operated by the city of Waco.

Cooperation

The NSF site uses untreated wastewater from the Waco treatment plant to test the proposed products and returns the treated effluent from tested systems to the treatment train when testing is completed.

"We have a consistently organically loaded, readily available supply of raw sewage to use," said Jumper. "We are, in essence, a side stream to the facility. The treatment plant has always been highly cooperative with us both before with Baylor University and now with NSF. We are anticipating continued mutually beneficial cooperation with the City of Waco."

BRA was chartered by the state of Texas in the 1930s to deal with flooding from the Brazos River. A series of flood control dams was constructed, the last in 1953, and flooding has not been a problem since. The BRA followed a natural progression and began operation of sewage treatment facilities in the 1960s in an effort to protect water quality in the Brazos River watershed. Today, the BRA operates several treatment plant facilities along the Brazos River.

The Waco wastewater treatment plant is a combined flow, extended aeration plant with primary and tertiary treatment. The 20-year-old plant receives 80 percent of its waste from the city of Waco, with the remainder coming from seven small surrounding communities.

The Testing Business

Although the Waco site is the only official NSF test site in the country, there are a couple of other NSF-approved alternative test sites, including one in Louisiana and one on the East Coast. In addition, there are other testing facilities.

"All manufacturers have to go through one of these sites in order to receive certification to be able to sell their product," said Jumper. "Most states have an alternative manner in which systems can be approved through a two-year process. In Texas, for example, you can come in and put in an agreed-upon number of systems and test those over a two-year period. Then, if you successfully pass, you can install systems in Texas.

"The problem with that is not only the lengthy time period, but it ends up being a certification that is only good in Texas. The NSF certification is widely accepted. Most states will recognize and approve systems that have been tested and certified by NSF International."

Jumper estimates there are 20 to 30 manufacturers of aerobic treatment units. Although the Waco site officially opened in March 2003, Jumper anticipates testing five to eight new units per year in addition to retesting presently certified systems as may be required by the seven-year retest cycle.

Preliminary Setup

The NSF test facility has undergone extensive remodeling recently. "The dosing and sampling systems at the facility have been streamlined

mechanically so it doesn't take a tremendous amount of oversight," said Jumper.

The testing facility offers controlled performance testing of limited duration. "This is truly just a means of establishing the capability of the tested equipment to make sure it will perform in the prescribed manner," Jumper added.

The prescribed manner is in accordance with the requirements of NSF/ANSI Standard 40 regulations. Systems are classified according to their biological, physical, and chemical characteristics and by the effluent they produce.

The units tested are typically aerobic treatment systems. "There are various designs on that theme that are tested and utilized," said Jumper. "We're seeing some unique designs these days. Manufacturers are very inventive and creative. People are moving into areas more environmentally sensitive around lakes and other waterways and in soils that are not necessarily fragile, but may not be as readily accepting of sewage that has an elevated organic content."

"With burgeoning rural development, it's almost impossible to be able to provide a sewage collection and treatment system to serve groups of homes with a broad range of site and topographic conditions over a dispersed geographic area. It's just not going to be feasible for that to happen. That means the onsite sewage facilities serve an important need and fill a real niche in terms of protecting public health and the environment from disposal of inadequately treated sewage. From what I've seen, the industry has adapted to these new demands."

The Process

Before a treatment system is delivered to the testing site, it undergoes a series of rigorous engineering reviews by other NSF personnel. "This can be lengthy or not so lengthy, depending on the preparation that's done by the manufacturer. We want to be sure that when the systems are cleared for testing that they're likely to pass and not have any difficulty with improper design or poor manufacturing processes," said Jumper.

Jumper checking the composited raw wastewater sample in the Isco refrigerated sampler.

Once a unit has passed the NSF engineering review, testing can begin. "At that point, I have in hand documentation that shows what the system to be tested should look like. This includes drawings and necessary specification to have a full understanding of how the system to be tested should be configured," said Jumper. "If there are any special needs, directions, or instructions from the manufacturer as to how the unit should be installed, I have that information, too."

The manufacturer or a direct company representative must be present during the delivery and installation process to ensure the unit is installed according to manufacturer specifications. "The way the unit is tested is how it is required to be manufactured, sold, installed, and operated in the future," said Jumper.

After a system is installed, Jumper does a secondary documentation with photographs and measurements being taken to verify that the unit that is brought in is the one that has been approved for testing.

Next, the unit goes through an infiltration/exfiltration test. "It is set in place above ground and filled with water to the overflow outlet and undergoes a 24-hour infiltration/exfiltration or leak test," said Jumper.

Concrete system manufacturers have the option of filling their units 24 hours in advance of this test because of normal adsorption of water by concrete. "The infiltration test is simply a 24-hour timed test. The water level is marked, and 24 hours later, the level is noted. If there is any change, it is marked, and it has to comply with a minimum amount of loss over that 24-hour period," said Jumper.

Units are permitted a 0.5 percent change from the initial water level. After the infiltration test, the system is then installed according to the manufacturer's specification.

Testing, Testing, Testing...

Without specific dosing instructions from a manufacturer, a standard dosing protocol is used for the initial dosing of tested systems. The unit is filled with two-thirds tap water and one-third raw sewage from the plant. Then, daily dosing begins for the system based on the Standard 40 requirements.

"It goes through the dosing schedule, and then the system is tested. The basic requirement for testing evaluation consists of 26 weeks of dosing," said Jumper. "During this period, the unit is dosed for 16 weeks under design loading and is followed by seven-and-a-half weeks of stress loading, which includes four non-ideal conditions for the unit separated by a week's rest in between them. Then, the final two-and-a-half weeks of design loading is administered."

Dissolved oxygen, pH, and temperature readings are taken in-situ.

The unit is dosed seven days a week, with samples being taken five days during the week. Dosing is designed to mimic residential use, since Standard 40 only addresses residential units.

A tested unit is dosed three times a day. In the morning between 6 and 9 a.m., it receives 35 percent of its daily hydraulic capacity. These systems are limited to between 400 and 1,500 gpd in treatment capacity. The second dosing starts at 11 a.m. and continues until 2 p.m., in which it receives 25 percent of its daily rate of flow. During the third and final dosing between 5 and 8 p.m., it receives the remaining 40 percent of its daily rated capacity.

"This is a way to apportion it and spread it over time," said Jumper. "Theoretically, people get up in the morning and use their facilities and shower, and there is also a peak at noon and in the evening hours.

"Obviously, there's no ideal or perfect condition under which to test a system, but you have to have something that's standard-based, uniform, and can be referenced and repeated as an empirical test to present a level playing field. When someone brings a unit to us, they have to be comfortable with the fact that their system is going to be tested just like everyone else's. We go to great lengths to see that that happens."

Stress Loading

At the end of the 16th week, stress loading begins. Jumper explained that stress loading consists of four, non-ideal conditions for treatment systems, designed to test the units under the more strenuous conditions that may occur in every day use. Each of these stress conditions are separated by seven days of design loading to allow the unit to return to its pre-existing condition.

"The infrastructure necessary to administer these tests makes testing an interesting process to conduct," said Jumper. "All the valves, timers, controls, pipes, and vents are in place to make all of this occur."

The four stress conditions are:

1. **Washday Stress**—This cycle consists of three washdays in a five-day period separated by a 24-hour period. The three washdays consist of three wash loads each, which include three wash cycles and six rinse cycles.

Checking the dosing containers.

2. **Working Parent Stress**—Under this five-day condition, the system is loaded and dosed with 40 percent of its hydraulic capacity between 6 and 9 a.m. and then, between 5 and 8 p.m., it is dosed with the remaining 60 percent of the hydraulic loading, consisting of one wash load and two rinse cycles.
3. **Vacation Stress**—On the day the vacation stress is initiated, the system is dosed at 35 percent of its daily hydraulic capacity between 6 and 9 a.m., 25 percent between 11 a.m. and 2 p.m., and then dosing is discontinued for eight consecutive days while the power stays on. On the evening of the ninth day between 5 and 8 p.m., the system is dosed with 60 percent of its daily hydraulic capacity, which includes three wash loads and six rinse cycles.
4. **Power Equipment Failure Stress**—During this five-day condition, the system is dosed with 40 percent of its capacity between 5 and 8 p.m. on the day the power stress is initiated. At 9 p.m., the power to the system is turned off. It is allowed to be off for 48 hours. After 48 hours, power is restored, and the system is dosed over a three-hour period with 60 percent of its daily hydraulic capacity that includes one wash cycle and two rinse cycles.

"Power failures do take place in actual application of these systems in the field, just like the rest of these test conditions," said Jumper. "It's a very thorough test. I do audits in the field, and I have seen systems installed and operated under every imaginable condition. They do undergo stress in the field.

"It's asking a lot of these systems and their design to be able to deal with this type of changing stress. We're talking about a biological community. If the system is not designed well hydraulically, in terms of its flow through and other design considerations, it will have difficulty being able to deal with this type of non-ideal condition. We have the infrastructure in place to ensure that our dosing volumes are very consistent. I can guarantee you the system is dosed within 1 percent of its daily-rated capacity."

Certification and Beyond

Once a unit has successfully passed the Standard 40 test protocol, it may be classified as either a Class I system or a Class II system, depending upon the level of performance documented during the test. Based upon performance, the system receives certification and may be sold and installed in states requiring certification. After seven years, the unit may be required to be completely retested.

Manufacturers pay the fees to have the testing performed. In addition, there are fees required to maintain certification every year. "It's an expensive process, and the manufacturers are the ones who have to carry that expense," said Jumper.

"It's the ongoing portion of the certification process that provides protection for public health and safety. Every year, the unit must undergo a complete audit at the manufacturing facility to make sure that the systems that were tested are actually being manufactured as they were tested. Otherwise, there would be no way to certify that there has not been any type of product modification without prior approval or testing.

"If a system has been altered, then all bets are off from our standpoint, because we can't certify performance unless we have either tested it or done an engineering review to determine how any changes might affect performance. That's a critical aspect of ongoing certification. Otherwise, regulators and the public can't rely on NSF testing and certification," said Jumper.

In addition, NSF requires manufacturers to record and document each installation. A minimum number of authorized representatives of each manufacturer are also audited annually as part of the manufacturer audit.

Sample collection enclosure with the refrigerator inside. The tee-cross and other risers associated with the system are in the foreground.

Close-up of a sample enclosure in a refrigerator. The peristaltic pump and sample timer are to the left.

"Authorized representatives may be individual "Mom and Pop" operations, an individual who simply buys directly and installs the systems, or a distributor who sells hundreds of units a year across the country," said Jumper.

"The audit performed on those authorized representatives is an opportunity to verify that a record is being kept of where the units are installed and that they have received required service. There's a requirement that these units receive a minimum of four visits from the authorized representative within the first two years they are installed. This maintenance component should be included in the cost of the unit."

Ultimately, the manufacturer is responsible to see that this documentation is done. This system provides "trackability" for a homeowner. "Let's say you're a homeowner. You buy a home that is 10 years old, and you move in and realize you have an aerobic treatment system in your yard. If you inspect the system, there will be a data plate on the unit in a couple of places so that you will be able to contact the manufacturer," said Jumper.

"Let's say you need an operator's manual to understand proper operation of the treatment system. You should be able to call the number on the data plate and give them a serial number and receive the manual. In this way, each unit has trackability. That's part of what ongoing certification is all about. Manufacturers have a lot of responsibilities in terms of care and operation of the unit they distribute."

The last step in making sure a unit is operating properly lies with the homeowner. "We can do a really good job ensuring the testing is done properly, and we do," said Jumper. "The manufacturer then, in turn, can build these systems and do a really good job at making sure their quality control is in place, and their authorized representatives in the field know what they're doing.

"The manufacturer ships the unit. The installer installs it. They comply with all the local, state, and Standard 40 requirements for installation, but if the homeowner is not educated about how the unit should be operated and maintained, all of that can be for nothing. That's a critical phase. If a system is not maintained and operated according to manufacturer's specifications and the way it was tested, it's not going to perform as it has been certified to perform."

Jumper said that many states now require a continued certification of the manufacturers and their products before they will allow them to be put on a list of approved systems for distribution and sale for prospective system buyers.

Failures

If a unit fails, is it back to the drawing board for the manufacturer? That depends on the nature of the failure and when it has occurred during the process, according to Jumper.

"Because we have to treat everyone the same, we can't get into helping them design their systems. We can simply tell them when it failed and show them the data points. Then, they need to figure out how to correct their situation. The truth is, with the influent stream being variable, this is not an exact science. This is one of the conditions that these units have to face in the field on any given day. The biochemical oxygen demand and total suspended solids of the influent stream can vary very broadly.

"That is the reason the test is at least six months long. It gives you an opportunity to look at the units over a greater period of time. If a unit fails, the manufacturer has choices. They can elect to restart the unit. They can come in and pump the unit, clean it out, and start over if they think it will perform better a second time around. Or they can redesign and bring in another unit. It's entirely up to them."

Jumper stressed that NSF acts as a third-party testing and certification body to verify performance; however, the manufacturer is responsible for making the units work in the field.

The Public Wins

As regulatory agencies have become more knowledgeable about the impact of sewage effluent on the environment and the receiving soils, regulations have become more strenuous with regard to performance testing and certification.

"The effluent streams from these units are much cleaner and this is important, given the types of soils that are receiving waste in many developing areas," said Jumper. "These systems are an attempt to address the need for a higher effluent water quality. Some of these systems have been applied to industrial and commercial use even though they are strictly intended for residential use."

Jumper added that with more than 25 percent of homes in the U.S. using onsite systems today, the need for more choices and more effective treatment is growing.

"Manufacturers are a very astute group of businessmen," said Jumper. "They know they can't rest on their laurels. They are inveterate tinkerers with their technology. They're constantly trying to improve their technology in hopes of gaining a competitive edge, of course. The result of their creativity is that their product is improved, and the public benefits from that in the long term.

"Testing and certification is an integral part of this success. All of this goes a long way toward protecting the health of the nation and the environment. It's a very effective process," he said.

For more information, contact **Jumper at jumper@nsf.org**.