Softener Discharge Versus Aerobic Wastewater Treatment Units

System Design is Key–Research Answers Questions in the Age-Old Debate

By David Averbeck, Mike Catanzaro, Jason Davis and Andrew Warnes

The debate over whether or not water softener discharge impedes the performance of on-site septic systems has dragged on for almost 30 years. The subject of the debate is critical because some jurisdictions (Michigan, Texas, Delaware, Connecticut and some municipalities in California) have limited or banned the discharge of brine into septic systems until conclusive scientific evidence is developed. Standard policy for on-site wastewater treatment system manufacturers is to void the warranty of their systems if water softener brine is discharged into their products. An important study undertaken by water treatment technology manufacturer Pentair is poised to take the debate one step further towards final resolution.

As a publicly traded corporation with approximate annual revenue of $3.3 billion (USD), Pentair is uniquely positioned to deliver technical expertise and support for this type of research. The company manufactures both ion exchange and wastewater treatment systems, and is widely recognized as a significant industry participant and technical leader in these segments.

The history

Perhaps the best summary of prior softener discharge/on-site waste treatment system debates appeared in the Winter 2001 edition of *Pipeline*, the newsletter of the National Small Flows Clearinghouse. It documented the history of the Water Quality Research Council (WQRC) and the Water Quality Association (WQA), which supported two studies in the late 1970s. One was by the National Sanitation Foundation (NSF International) in Ann Arbor, MI, and the other conducted by the Small Scale Waste Management Project (SSWMP) at the University of Wisconsin in Madison. Both studies compared the performance of home sewage treatment systems with and without added water softener brine.

The two studies were designed to help answer questions consumers ask about their water softeners. The SSWMP research sought to determine if a water softener's brine affects a drainfield's ability to absorb wastewater. NSF investigated whether the influx of brine from a water softener's regeneration phase affects the processes that occur in an aerobic treatment system. Researchers also investigated whether additional water discharged during backwash and regeneration (up to an extra 50 gallons [189 liters]) into the septic tank interferes with the settling and floatation processes.

NSF researchers used individual aerobic wastewater treatment units to study possible effects the brine might have on treatment processes in the tank. The normal performance of both septic tanks and aerobic tanks depends on the presence of active bacteria living in the system. These bacteria help break down the solids and dissolved nutrients in the wastewater.

An aerobic treatment system relies upon bacteria that utilize oxygen to achieve this task, whereas, an anaerobic system (such as a conventional septic tank) treats wastewater by using bacteria that can function in conditions lacking oxygen. If high doses of sodium from water softener regeneration and other household products flow into the tank, bacteria could be affected. If bacteria are negatively affected, the system might not operate at its full potential, and some solids and/or dissolved nutrients might not fully decompose.

NSF researchers found that brine wastes had no negative effects on the bacterial population living in the aerobic treatment tank, even when the system was loaded with twice the normal amount of brine. Tests determined that water softener wastes actually help with treatment processes.

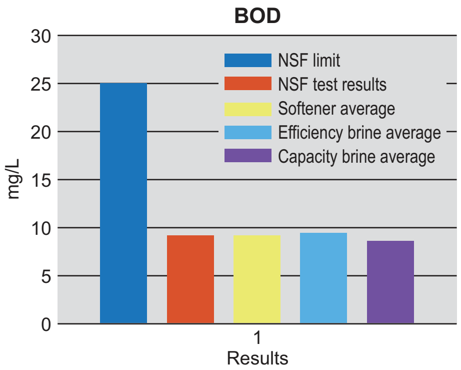
WQA's final report states that the brine has "a beneficial influence on a septic tank system by stimulating biological action in the septic tank and caused no operational problems in the typical anaerobic septic tanks or the new aerobic treatment units." In other words, the researchers in this study found that microorganisms living and working in a home aerobic treatment system are not harmed by water softener salts.

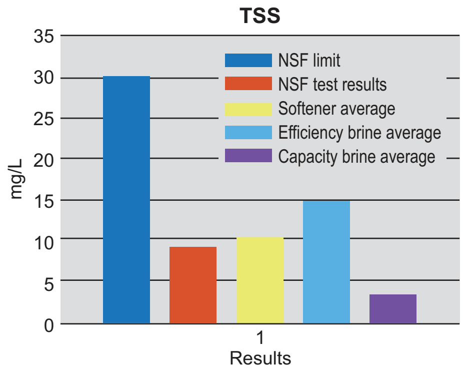
Researchers also found that the additional amount of water discharged to a treatment tank during the regeneration process had no negative impact. The question concerned whether the volume and flow rate of the regeneration brine might overload the system and cause carryover of solids into the drainfield.

The study found that the volume of water discharged was comparable to or less than that from many automatic washing machines and other household appliances. Researchers also found that wastewater flowed into the treatment tank slowly enough so that it caused minimal disturbance.

The study at the University of Wisconsin-Madison examined whether regeneration brine affected the soil in a septic system's drainfield. This research was prompted by the common knowledge that sodium causes some soil particles to swell, thereby reducing water's ability to seep readily through the soil.

Researchers found that the water softener regeneration brine did not reduce the percolation rate of water in the absorption field of a normally operating septic system. This conclusion was reached because while brine not only contains just sodium, it also includes significant amounts of calcium and magnesium. The calcium in the brine acts similarly to gypsum, a calcium-rich substance routinely used to increase the porosity of clay soils in agriculture. The research report stated that calcium, therefore, helps counteract any negative effects of the sodium. Most water softener manufacturers and many industry experts agree with the WQA's position.





Some don't agree

As with most scientific research, these two studies answered each of the proposed questions under the specific conditions of the research project. Because other variables exist that weren't part of the study's protocol (e.g., problems that might occur because of a poorly functioning home water softening unit), some people feel that more research needs to be done to completely resolve the disputed issues.

The NSF study, for example, used an aerobic treatment tank rather than an anaerobic tank (a conventional septic tank). Conventional septic systems are much more common than aerobic treatment units. An aerobic system often has a pretreatment tank to settle out much of the solids. Aerobic systems require air to be injected into the tank to support the growth of the suspended or attached aerobic bacteria that digest solids and dissolved nutrients in the wastewater. The wastewater in the tank is constantly stirred via aeration.

On the other hand, a conventional septic tank separates solids from wastewater by settling. In a properly functioning conventional system, most of the solids sink to the bottom of the tank leaving the liquid portion relatively clear. The anaerobic bacteria do their work without the wastewater in the tank being agitated.

Would the same results have been found if a conventional septic tank had been used? Many experts agreed that more research was needed to resolve these and other potential issues.

What's new?

In 2009, Pentair embarked upon a detailed technical investigation into the issues surrounding the brine versus aerobic treatment unit (ATU) debate. In order to ensure the highest possible standards of technical accuracy and objectivity, testing was done at an ANSI-accredited independent laboratory. System operation, sampling and analysis were performed by Gulf Coast Testing LCC, located in Prairieville, LA.

The laboratory is contracted by NSF for *NSF/ANSI Standards 40: Residential Wastewater Treatment Systems* and *245: Wastewater Treatment Systems – Nitrogen Reduction* testing. BOD, TSS and pH analyses were performed per APHA's *Standard Methods for the Examination of Water and Wastewater.*

The wastewater treatment system tested was a Delta Environmental ECOPOD certified to *NSF/ANSI Standards 40* and *245* with a rated capacity of 500 gpd (1,892.7 L/d). It included a 500-gallon anaerobic pretreatment tank and had recently, successfully completed a six-month *NSF/ANSI 245* certification test.

The water softening system utilized was a widely commercialized one-cubic-foot softener with a Fleck 2510 electronic control valve connected to municipal feedwater. The softener was exhausted between regeneration cycles, with the softened water discharged to domestic sewer (not to the waste treatment unit) to ensure that the softener waste would have the appropriate ion 'mix'.

The softener drain was introduced to the anaerobic pretreatment tank at an inlet tee, and commercially available softener salt (NaCl) was used for regeneration. The softener was regenerated every two days at 2:00 a.m. with varying brine doses as outlined in the data presented here.

Introducing the softener waste at 2:00 a.m., and directly into the pretreatment tank, was intentional as this represents the worst-case scenario—there is no dilution of the waste from other flows or from residual water in the wastewater piping system.

Wastewater was dosed to the system as per *NSF/ANSI 40* guidelines for design loading of a 500-gpd system and baseline data was taken before softener discharge was introduced to the

About the relevant ANSI/NSF Standards

ANSI/NSF Standard 40

Standard 40 is for residential wastewater treatment systems having rated capacities between 400 gallons (1,514 liters) and 1,500 gallons (5,678 liters) per day. The standard is not restrictive in the type of treatment technology. Any system can be evaluated.

The standard includes a wide range of product evaluation methods and criteria for residential treatment systems. Most notably is the ability of the treatment system to produce an acceptable quality of effluent.

This is demonstrated during a six-month (26-week) test where wastewater of required strength is subjected to the system at the rated capacity of the system as evenly dosed at periods prescribed by the standard. Stress sequences are included to simulate wash day, working parent, power outage and vacation conditions.

The effluent criteria required of a Class I system is based on the US EPA secondary effluent treatment requirements for municipal treatment facilities. Testing can be performed at several test facilities.

In addition to the effluent performance, requirements also exist for product literature, including installation, operation and maintenance, and troubleshooting and repair manuals. The system must also meet minimum requirements for structural integrity, leakage, noise, electrical certification, access ports, failure sensing and signaling equipment (visual and audible alarms), flow design, data plate and service labels.

ANSI/NSF Standard 245

This standard has been developed for residential wastewater treatment systems designed to provide for nitrogen reduction. The evaluation involves six months of performance testing, incorporating stress tests to simulate wash day, working parent, power outage and vacation conditions.

ANSI/NSF Standard 245 is set up to evaluate systems having rated capacities between 400 gallons (1,514 liters) and 1,500 gallons (5,678 liters) per day. Technologies testing against *Standard 245* must either be *Standard 40*-certified or be evaluated against *Standard 40* at the same time an evaluation is being carried out for *Standard 245*, as both tests can be run concurrently.

Throughout the testing, samples are collected during design loading periods and evaluated against the pass/fail requirements. A treatment system must meet the following effluent concentrations averaged over the course of the testing period in order to meet *Standard 245*:

- CBOD5 - 25 mg/L • TSS - 30 mg/L
- Total nitrogen - at least a 50 percent average of influent TKN
- pH - 6.0 to 9.0 SU

system. The softener was regenerated every two days at the two salt-dose extremes: maximum efficiency (four lbs./cu.ft.) and maximum capacity (15 lbs./cu.ft.). The systems were operated for a minimum of three weeks at each dose.

To monitor whether the softener discharge disrupted solids settling in either the anaerobic pretreatment tank or the aerobic treatment tank the sludge blanket was monitored in both tanks with a *sludge judge*. It was found that the sludge blanket was not disrupted, the system maintained good separation of the sludge blanket, and clear zone at both salt-dosage settings throughout the test.

The results

The most significant pass/fail criteria of *NSF/ANSI Standard 40* are those pertaining to biological oxygen demand (BOD), total suspended solids (TSS) and pH. The test results were:

- BOD maximum allowable 30-day average = 25 mg/L
- Before softener average = 9.0 mg/L
- After softener average = 9.0 mg/L
- TSS maximum allowable 30-day average = 30 mg/L
- Before softener average = 9.0 mg/L
- After softener average = 10.3 mg/L
- pH allowable range = 6 to 9
- Before softener average = 7.4 mg/L
- After softener average = 7.4 mg/L

Conclusions

Performance of the Delta Environmental ECOPOD was virtually the same with and without softener discharge and was well below *NSF/ANSI 40* limits with and without softener discharge. Additionally, Delta Environmental's field experience uncovered zero instances of on-site treatment system failures linked to softener discharge.

Upon completion of the first rounds of testing, process experts at Delta stated: "we recognize that some advanced wastewater treatment technologies are not compatible with water softener discharge brine. Non-compatible technologies can cause problems ranging from maintenance issues to catastrophic failure.

"The utilization of spray nozzles, screens, inappropriate operating levels, media types, etc., or combinations thereof, contribute to potential maintenance issues/failures. The Delta ECOPOD system has no nozzles, screens or any other components that can clog. The media in the Delta's ECOPOD system is completely submerged in the reactor chamber, which allows for the maximum operation capacity of the unit."

Delta is confident enough in the data developed to date that it has announced it will be modifying its warranties to accept the use of Delta-approved, demand-initiated, twin-tank water softener systems with the Delta ECOPOD. Delta will be notifying various third-party agencies, as well as state and local regulators, of this significant development.

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